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SOCIOLOGICAL ASPECTS OF PRODUCTION COMMITTEES

THE critical importance of establishing effective relations between management and workers in relation to production has been noted in more than one report of the Select Committee on National Expenditure, and one of the main objects of the Joint Production Advisory Committees now being set up is to assist in such integration and to eliminate the misunderstandings which arise when, for example, workers are unaware of the real causes of idle time and other interruptions in production. This factor, it should be noted, is increasingly liable to operate as the mobilization of our industrial man-power and woman-power approaches its limits. There is less and less margin to prevent an interruption at one point causing delays and even more serious interruptions elsewhere.

The value of such attempts to give the workers a true picture of the situation has been well illustrated in a recent visit of a deputation from a local trades and labour council to an ordnance factory, which was reported in the House of Commons. The deputation had full liberty to talk to any employee or shop steward, and the conversations described in the report show how unfounded most of the complaints of idle hours, idle machines and lack of sympathy between management and workers proved to be, and how high an opinion the deputation formed of the personnel and welfare management of the factory compared with private industry. Sir Frederick West, chairman of the North-Western Regional Board of the Ministry of Production, commenting on unfair and inaccurate statements in the report of the Amalgamated Engineering Union on war production with reference to management, confirmed that the Regional Board's own experience in dealing with allegations and rumours criticizing management had indicated that they were mostly unfounded or grossly exaggerated. More substantial grounds of criticism, it is true, are revealed in the investigations of complaints regarding two royal ordnance factories described in the Ninth Report of the Select Committee on National Expenditure, but even here the report shows that the troubles were very largely those which are invariably experienced in starting a factory with an excessive proportion of untrained workers. The superintendents of both factories were fully alive to the problems which confronted them and were doing their utmost to overcome difficulties. Many of the allegations were considerably exaggerated and on most of the matters action had already been taken, though the Select Committee's recommendations, particularly in regard to supervision, the co-ordination of inspection and production, the keeping of records, the handling of transport difficulties and the abolition of Sunday work have a much wider pertinence than in the two factories investigated.

The value of the Joint Production Committees as a weapon of democracy, enabling workers and employers to collaborate in one common and urgent

drive, receives powerful support in a recent broadsheet of Political and Economic Planning (P E P). The workers, accepting the responsibility of full participation in the war effort, are beginning to think in terms of 'we' instead of 'they', and are proving that as efficient collaborators they can be far more than mere mechanical factors of production. By enlisting the intelligence and experience of the men who work with their hands, these Committees enable us to make fuller use of the man-power of Great Britain, and they should in this way do something to meet that shortage of efficient and experienced managers which in places so seriously handicaps our war effort.

If at the same time the fresh brains give an impetus to co-operation and improve the efficiency of production, the Committees will prove themselves unmistakably weapons of war, with the advantage that they could equally prove weapons for winning the peace. The importance of the Production Committees should not in fact be judged only by the extent to which they improve the organization of production. They should be judged also by the changes they effect in the attitude of workers and managements to each other in production relations. It is probable that the Committees will strengthen rather than undermine the trade union movement; they may also lead to a more open mind and a wider outlook on industrial and social affairs on the part of organized labour. This should facilitate the handling of some of the problems of post-war reconstruction as much as it will immediately further the contribution of the workers of Britain in the world-wide struggle for democracy.

The Joint Production Committees are an essentially new development, the strength and significance of which cannot yet be adequately judged, and there are still many obstacles in the way of their success. Some managers oppose them as a superfluous addition to an already widely ramified administrative system. Some trade unionists, on the other hand, are resisting the new Committees on the ground that they are instruments of that industrial collaboration which they have always fought.

Political and Economic Planning has therefore rendered a national service in bringing out so promptly a broadsheet which outlines the facts and sets this new development in its true perspective against the Whitley reports and the experience of works committees and councils, as well as sketching the growth of Production Committees up to their official recognition in February 1942. Success or failure of individual committees will undoubtedly depend largely on the personality of the chairman. He must be capable of bringing out the best in the members, encouraging them to speak frankly, and inspiring open-mindedness, independence and energy. Trade unionists, however, have also a great responsibility for the success of the Committees, and they should not fail to realize the important part which the Committees may play in promoting efficiency. Moreover, this development is so clearly in line with movements in the industrial life of our allies, the United States of America and the U.S.S.R., that it may be of great significance in furthering co-operation with these great countries after the War in the task of restoring order and hope and a new standard of living to the shattered world.

While the main purpose of these developments is to promote the efficiency of our war effort, they have a long-term objective which should not be overlooked. We cannot hope to build a new and more equable social order after the War without mutual confidence and trust between management and workers. The standard of industrial relations which best serves the nation's immediate purpose in war is exactly that which best promotes social justice and order in times of peace. There could be no better illustration of this than the coal industry, in which the attitude of both workers and employers has often been a serious threat to the war effort. What is no less apparent to every impartial observer is the high price which the nation has had to pay for such intransigence and sectionalism in the past. The repercussions on our social economy as a whole in the past twenty or thirty years make the coal industry the very first place where the Government should be required to prove that private and sectional interests shall no longer be allowed to obstruct the national purpose.

The highly suggestive report on "Fatigue of Workers: its Relation to Industrial Production" which was published last year in the United States by the Committee on Work in Industry of the National Research Council, is of particular interest in this connexion. It is no disparagement of the scientific or technical work on the elimination of fatigue, the improvement of conditions of work and prevention of accidents, to emphasize, as this report does, that such physical conditions may be of secondary importance compared with the psychological or social conditions. Neglect of the latter has undoubtedly been a main factor in the persistence of such unhappy conditions in the coal industry.

The National Research Council's report is in the tradition of that line of fundamental research on which Dr. Elton Mayo lays such stress in his stimulating volume "Human Problems of an Industrial Civilisation", and it includes some account of those researches at the Western Electric Co. at Hawthorne which are described in that book as well as in T. N. Whitehead's "The Industrial Worker" and elsewhere. This section of the book, together with the chapter which summarizes and discusses Mr. C. I. Barnard's book "The Functions of the Executive", give it a significance far beyond that indicated by its title, and it merits careful study by all those concerned with the improvement of industrial relations, whether from the point of view of war production or of reconstruction after the War.

One of the most striking features of the book is the illustration it gives of the lack of knowledge of each others' minds and purposes on the part of management and worker even in such a progressive firm as the Western Electric Co. The investigators formed the opinion that management really knew very little about what constituted good supervision, or what the employees thought about their conditions of work. This lack of communications is responsible

for the failure to secure the desired results even when good working conditions have been established. An executive order without the participation of the workers may be, and often is, ineffective.

The report points out that, pre-occupied with the continual study of its methods so as to make them more efficient, and making inaccurate assumptions about the motives and behaviour of employees, management gives a series of orders which are transmitted through a hierarchy of supervisors to those doing the physical work. At that level the action does violence to the workers' sentiments and is felt to be a threat to their informal organization, and restrictive or protective action by the workers results. Because technical organization is geared to rapid change, while social organization cannot change rapidly, the latter tends to protect itself by retarding change.

The question of communication itself, however, is both upwards and downwards. Where it is fully established and the worker understands the changes that are proposed and the purposes to be served, co-operation becomes effective and the difficulties tend to disappear. Where for any reason communication both upwards and downwards is good, satisfaction is high and authority is strong.

It is therefore of the utmost importance for management to ensure that the generalizations on which it must in practice rely are accurate and not weighted too heavily by the logic of efficiency and economics. Equally, it must recognize the way in which authority arises out of the collaboration of the individuals affected. The first responsibility for the establishment of communications is that of management downwards, for failure in that direction is at once the cause of failure in the upward direction from the worker.

The second outstanding point which emerges from this report and the researches at the Western Electric Co. is the demonstration of the significance of informal organization. Such organization always exists in conjunction with formal organization, but the importance of its two functions are only now becoming recognized: to transmit information and understandings which, for one reason or another, cannot be transmitted by the formal communication system, and to allow means for individuals to escape from certain effects of formal organizations which tend to disintegrate the personality. The place of the social group in industry presents indeed a most promising field of investigation, for the autonomous groups of M. Dubreuil's scheme are by no means the only means of eliminating the sense of frustration or repression of individuality which large-scale mechanized industry, however well directed, is apt to engender.

No one can put down this highly suggestive report without realizing how much we have yet to learn from the formal study of human organization, both in furthering the war effort and in building the peace. What Mr. Barnard has to say about the aspects of executive work which are aimed at securing co-operation are also important. Purpose is indeed the unifying principle of organization, and experience of nearly three years of war endorses all that the report observes on this point. What is required to date is in fact to interpret the nation's purpose and its needs so that they are understood by every citizen upon whom it calls for service. Only such understanding and acceptance can call forth the immense moral as well as physical effort required to carry the United Nations to victory. In Great Britain no less than in the United States, the committee of the National Research Council has made a noteworthy contribution to creative thinking and to social and industrial efficiency which has both short- and long-range significance.

CRATER LAKE

Crater Lake: The Story of its Origin

By H. Williams. Pp. xxii + 100 + 10 plates. (Berkeley, Calif.: University of California Press; London: Cambridge University Press, 1941.) 10*s*. 6*d*. net.

WE have good reason to be grateful to both Canada and the United States for their contributions to peace as well as to war. Among their most precious gifts are the national parks of the glorious West, which they have consecrated for all future time to the service of humanity. The larger examples, such as Jasper, Yellowstone and the Grand Canyon, harbour men and bears on terms reminiscent of the Garden of Eden. The park of Crater Lake, Oregon, covering roughly 300 square miles, of which a tenth is submerged, is too small to share in this particular distinction; but the blue of its lake and the gay tints of the surrounding cliffs lead some of its devotees to acclaim it as the most beautiful place in the world. Perhaps these enthusiasts have never visited that other park which contains Lake Louise in Alberta; perhaps they say 'most beautiful' when they really mean 'most fascinating'. Be this as it may, all who have had the privilege of visiting Crater Lake admit its rare loveliness, combined with an intellectual stimulus of quite exceptional quality. It is scarcely possible to stand on the rim of the crater and avoid asking the question: How did it happen?

Fortunately, the two great countries concerned, each within its own boundaries, in the conduct of the national parks of the West clearly recognize the educational possibilities of these institutions. In the United States, J. C. Merriam, chairman of the appropriate committee of the National Academy of Sciences, has helped and encouraged Howel Williams to produce the booklet under notice, which goes far to satisfy the most inquiring visitor. The booklet is excellent in plan, language and illustration—including two coloured plates by Paul Rockwood—excellent, in fact, in all respects but price.

The booklet is in two parts: the first aims at describing the changing scenes of the past as though recorded by a succession of eye-witnesses; the second at presenting some of the evidence in the form of a discussion between a Park Guide and a group of questioning tourists.

The first part is quite unusual. It adopts in language the technique of the illustrator, who occasions no surprise if he does portray in picture, model or diorama the details of an imagined scene of long ago, where only broad outline has really been established. Thus Howel Williams tells of the growth

of Mount Mazama, and of the destruction of its summit to yield a caldera site for Crater Lake, with the same confidence in print as Paul Rockwood manifests in paint. Here is what we read of the entry, be it remembered in prehistoric times, of Mount Mazama upon the phase of explosive activity that served as prelude to the stage of caldera formation:

"The opening day was clear and the morning light shone brilliantly on the ice around the summit. Suddenly there was an ominous rumbling underground, and a moment later a plume of steam rose from the crater. The slumbering volcano had awakened."

One is reminded of the younger Pliny's account of the resurrection of volcanic activity at Vesuvius, A.D. 79, an account which many historical critics in after-centuries considered fiction until at last it was confirmed by excavation of Pompeii and Herculaneum. Howel Williams's story of Mount Mazama is, of course, a geological novel, written by an author who has felt at liberty to clothe the essential facts of research in trappings of make-believe so transparent that they can be trusted to deceive no intelligent student.

The second part of the booklet marks, as Rastall has recently pointed out in the *Geological Magazine*, a reversion to the procedure of Plato's dialogue. A Guide is beset with every type of question that might occur to an inquisitive visitor. I agree with Rastall that the ordeal is handled very successfully.

Here is the main theme: the caldera which holds Crater Lake, six miles in diameter, obviously replaces the central portion of the volcanic peak to which the name Mount Mazama has come to be attached in geological literature. The old, old question arises: Has the replacement occurred through explosion or subsidence? The Guide supports with figures the verdict that has long been accepted, namely, that subsidence has been predominant. He estimates that 17 cubic miles of old volcano have disappeared; and in the volcanic ashes spread over the country at about the same time as the caldera formed he can only find 1½ cubic miles of fragments of old volcanic material.

Having decided that 15½ cubic miles of volcano have sunk in the process of caldera formation, the next main question is: How was room provided to receive the downfall? Here it must be understood that the old volcanic fragments just referred to are a minor feature in ashes consisting mainly of contemporaneously formed pumice. This latter has the following bulk composition expressed in cubic miles: 2 of crystals + 3 of glass + 5 of bubbles.

Neglecting the bubbles, the Guide concludes that the expulsion of this pumice made room for 5 only of the 15½ cubic miles of downfall. The remaining 10½ cubic miles he accommodates by postulating a sudden withdrawal of a corresponding volume of magma through injection into subterranean cracks.

From this distance, one is tempted to inquire whether it is justifiable to omit the enormous output of vapour in striking a volume-balance between expulsion and downfall. Admittedly the 5 cubic miles of bubbles owe most of their volume to reduction of pressure; but presumably they represent only a small fraction of the volatiles actually released.

Let us now take up another interesting point. The Guide is able to show that the pumice-ashes first of all fell like snow through the air to lie, as a comparatively thin sheet, indifferently on hill and dale; but that later outpourings of similar material rolled along the surface as glowing avalanches to choke valley bottoms in the Peléan style, which was first correctly interpreted in the West Indies by Flett and Tempest Anderson. The Guide quite convincingly bases his recognition of the glowing avalanche type upon the restriction of the material to valley bottoms. I remember, however, that in 1933, without the assistance of this criterion, which depends upon a survey of the district, I felt sure that I was looking, in one of these valleys, at a cooled representative of what had been a glowing avalanche, because it showed well-developed columnar jointing. A glowing avalanche is, after all, a close relation to a lava flow.

Still another point raised by the Guide concerns the texture of the widespread fallen ash. The material is definitely coarser at the top than at the bottom. The Guide deduces from this observation an increase of explosive violence during the eruption, thus permitting of carriage of bigger and bigger fragments high into the air. Again, at this distance from the evidence, one may ask whether a reverse inference is not preferable; whether in fact there was not in the initial stages so strong a blast of gas as to produce a finer spray of pumice than could be maintained later in the proceedings. On this alternative interpretation, the final boiling over of the glowing avalanches, which, by the way, carry the biggest fragments of all, would be a sign of still further failure of gas supply, not, as the Guide imagines, the culmination of a crescendo.

If space permitted, it would be possible to draw many apposite comparisons between Crater Lake and its ancient deeply eroded predecessors at Glen Coe, Ben Nevis and Mull. One obvious conclusion is that Mount Mazama may have sunk much more coherently than is suggested in the sections that illustrate this booklet.

Now for a last remark. The Guide shows that the glowing avalanches contain most of their crystals in their upper layers. This is a repetition of a condition found by Kennedy in certain composite lavas of Scotland, which, strongly porphyritic above, are non-porphyritic below. The inference in either instance is clear: the porphyritic material now at the top of the bed of ash (or lava, as the case may be) must, before extrusion, have underlain the accompanying non-porphyritic material in the volcanic pipe. The Guide is certainly justified in his interpretation of this relationship as evidence of settling under gravity.

In conclusion, I wish to thank the author and all concerned for a booklet in every way worthy of its great subject. Readers on turning to its pages will realize how inadequate is the present restricted notice.

E. B. BAILEY.

THE HISTORY OF SCIENCE

A History of Science and its Relations with Philosophy and Religion

By Sir William Cecil Dampier. Third edition, revised and enlarged. Pp. xxiii+574. (Cambridge: At the University Press, 1942.) 25*s*. net.

SIR WILLIAM DAMPIER is to be congratulated on the appearance of a third edition of his history of science. The first edition, published in 1929, was quickly sold out, a second appearing early the following year. This edition has long been out of print. For a large, rather expensive book, which scarcely appeals to specialists, which is no help in

passing examinations, which, though meant for the general reader, will be tackled only by the tougher members of the species, this is most encouraging. It shows there is a genuine interest in the history of science. Indeed, since 1929 a great deal has been done on the subject. Dr. Sarton's monumental work is going ahead; the journal *Isis* has published much valuable material, and excellent studies of special subjects and special periods have appeared. However, here is a comprehensive view in a single volume that need fear no rival for many years to come.

Comparison of the first and the new edition shows that many passages have been revised and generally improved. To avoid altering the numbering of the pages passages have also been omitted, and a few of these are perhaps to be regretted. There are many new citations of literature which greatly increase its value as a work of reference. A new chapter, the eleventh, has been added to record the scientific advances of the period 1930–1940. Many readers will turn to this first and most unfairly judge the book by it. It does seem a bit scrappy to read; it could scarcely be otherwise. The only alternative to this chapter would have been a complete rearrangement and almost complete re-writing of more than a hundred pages, and those probably the hardest to write. In any subject the nearer the historian comes to his own day the harder it is to be comprehensive and judicial. In science, where the rate of discovery in many branches in the years between the wars was becoming breathless, the difficulties are appalling. It is safe to predict that almost anybody reading this last chapter will conclude that his own pet subject scarcely gets its fair share and that certain subtle points have been dealt with rather crudely, but that other subjects are treated very fairly or even get more attention than they deserve.

The first thirty years of the twentieth century were the most spectacular in the whole history of science. The fourth decade did not appear so spectacular, but who knows what is to come? True, what Sir William Dampier has to record is mainly steady progress in many branches and no startling revolutions. The sky is clear, but the barometer is not steady. In biology none of the old controversies are really settled. Detailed knowledge accumulates, too fast almost, but general principles are lacking. In physics it is much the same. Physical theory, if the outsider may venture a remark, goes from bad to worse. There used to be one fundamental simplicity to cling to, namely only two ultimate, permanent, massive entities, electrons and protons (with photons as additional honorary members). One seemed to understand how these were necessary and sufficient. Now there are admitted to be several more, there is no apparent reason against any number of ultimate entities, and they are not so permanent after all.

Classical mechanics was the outcome of studying a narrow range of velocities and magnitudes (the moon and the apple.) By this over-simplification of the problem it succeeded in finding simple and useful working rules, but anything like a complete solution meant considering also the very fast, the very small and the very large. So also, in studying the general problem of the nature of matter, classical physics and chemistry were confined to a very narrow, easily accessible range of conditions and found useful but complex, numerous and ill-co-ordinated working rules. Twentieth-century physics, by going outside this range and investigating intense electric fields, extremely low densities, extremely high densities, extremes of temperature. and so on, has obtained much wider understanding and simpler generalizations; but it is pretty clear that nothing like finality has yet been reached.

The mathematics of physical theory always made it too difficult for the outsider to understand properly, but he used to comfort himself with the thought that the experts were agreed and therefore must be supposed to know. Now even this comfort seems to have gone. Moreover suggestions that some or all of the fundamental laws of physics are *a priori* seem to be gaining ground. Strong objections have been made to this notion, but the objectors do not seem very clear why they object. To work out a completely deductive cosmological theory is evidently possible in principle; it only needs brains. At least one empirical generalization would be necessary before it could be applied, but there seems to be no inherent reason, apart from imperfections in the theory, why there should be more than one. After that all the rest would be *a priori*.

If doubts and difficulties and unsolved problems accumulate, that is no reason to despair of science. Anyone who does despair and longs for the lost infallibility of the nineteenth century is making the false assumption that the material universe is such a paltry affair that a mere twenty-six centuries of intermittent investigation is enough to get to the bottom of it. This appears to be one of the morals to be drawn from the history of science. The other seems to be that, though no problem is finally completely solved, ingenuity and hard work can produce solutions that are valid within limits and within those limits a permanent gain. A. D. RITCHIE.

APPLICATION OF SCIENCE TO HUMAN NEEDS

Scientists Face the World of 1942

Essays by Karl T. Compton, Robert W. Trullinger, Vannevar Bush. (Rutgers University, Publications of the 175th Anniversary Celebration, No. 3.) Pp. vi+80. (New Brunswick, N. J.: Rutgers University Press, 1942.) 1.25 dollars.

THIS small book consists of three essays by Karl T. Compton, Vannevar Bush and Robert W. Trullinger, and three commentaries on these essays by Harvey N. Davies, Detlev Bronk and S. W. Fletcher. Although Dr. Bush relates his contribution primarily to the biological and Dr. Trullinger to the agricultural aspects of scientific development, the theme of each of the essays is the problem of how best to apply the enormous accumulation of scientific information in an economic manner to meet human needs and desires.

Dr. Compton discusses the progress which has been made in the fundamental sciences of physics, chemistry and biology and in certain of the applied sciences, and relates the extent to which it has been necessary to discontinue work in these fields in favour of investigations bearing more directly on the prosecution of the war effort. This is directing the attention of large numbers of men of science both in Great Britain and the United States to the sort of problems which confront the engineer acting in his normal capacity, and the benefit will be of long standing. These men of science are contributing to the development of new engineering tools such as special types of thermionic valves, alloys, plastics, etc., and their

influence will accelerate considerably the already established trend away from the empirical towards the analytical approach to the solution of engineering problems.

The most interesting feature of the essays is, however, the broader use of the title of engineer than has been accepted as yet in Great Britain. The agricultural engineer discussed by Dr. Trullinger is by no means unknown in Great Britain, but even if the biological engineer, whose function is described by Dr. Bush, has been conceived, one has not heard of the introduction or consideration of the special courses of study which are evidently being contemplated in the United States. Whether we shall consider it necessary in due course to make special provisions for the training of those men whose function it will be, according to Dr. Bush, to supervise and control the application of the results of scientific research and the products of technical development to the biological aspects of the food, fermentation and clothing industries, sanitation, housing and medicine is uncertain. Whether we should call him a biological engineer is doubtful. We have accepted the chemical engineer, however, to advantage and at least we should avoid lagging unduly in our consideration of the needs in question.

The comparison with chemical engineer presented by Dr. Bush covers a point which it will be well to keep in mind from the beginning. He says: "When the chemical industry first began its phenomenal growth in this country there were primarily two types of professional men involved, chemists who manipulated test tubes and retorts in laboratories, and mechanical engineers who built and operated pumps and tanks in plants. What more natural than to create chemical engineers by giving them a scanty chemical training, and an equally scanty training in mechanical engineering? The result was not a happy one, and it was not improved until a group of men, notably William Walker, created a new philosophy for chemical engineering based on the concept of the unit process. The chemical engineer of to-day is a far different individual from a mere hybrid chemist-mechanical engineer; he has a whole approach and a set of thought processes which are uniquely his. He differs from the chemist in much the same way that the electrical engineer differs from the applied physicist, and he has avoided being superficial in two subjects by creating a third in which he can be decidedly thorough.

"Much the same sort of evolutionary procedure is to be expected as the profession of the biological engineer develops. He does not need to attempt to create a new approach to the science of biology, nor does he need to essay a novel recast of the economics of business practice. He very much needs to produce a unique handling, at the professional level, of the combination of applied biology and its practice in industry."

Dr. Bush's essay does not leave one with a very clear picture of the intended function of the biological engineer and of the precise nature of the education and training he should receive. He says, however: "the engineer who designs and builds a plant in which a wide range of chemicals are produced and processed by biological methods will need to know something of bacteriology, of molds, of fungi, something of chemistry, a bit about energy transformations, perhaps some thermodynamics, and a good deal of mechanics. It would not be at all surprising, the way things are going, if he would need to know something of electronics. He will not be a master of all these, and if he attempts to become thus omniscient he will defeat his own purpose. He can, however, learn the entrances and how to go further."

It seems that special courses of study for agricultural engineers are available in forty-eight land-grant institutions. In the opinion of S. W. Fletcher, however, few of these have developed as yet "a distinctive curriculum having a characteristic core of studies" and he echoes views now obtaining wide acceptance in Great Britain in similar connexions when he writes:

"Here is the primary reason why so many graduates in agricultural engineering fail to meet the stern requirements of industry. It is common observation that those who have had adequate training in basic subjects with a moderate amount of training in specialised techniques are better able to adapt themselves to the constantly shifting requirements of agriculture and industry than graduates of highly specialized curricula."

"The charter of the land-grant institutions sets as their goal 'a liberal as well as a practical education'. A liberal education is defined by the Society for the Promotion of Engineering Education as 'The knowledge and practice of those intellectual pursuits, principles of living, and avocations which tend to broaden human interest and sympathies and to contribute to personal happiness and social welfare'. The public has a right to expect that graduates in agricultural engineering will be more than good technicians."

WILLIS JACKSON.

WORLD AFFAIRS

Out of the Ashes

A Survey of the Unhappy Lands and a Design for International Harmony. By Thorburn Muirhead. Pp. 231. (London: Robert Hale, Ltd., 1941.) 10*s.* 6*d.* net.

THIS is the first attempt to put together the state of the world, after the Russian war but not including the Japanese. It is mainly a sketch of the British Empire, and is useful as showing the universal vigour of the island conquerors as soon as they took up the trail in the sixteenth century. It becomes an empire, and conquest was involved, but there was never any idea of world dominion. Trade, profit, adventure and the settlement of the New World led Great Britain by the end of the nineteenth century to be the premier Power in the world and an object of offence to other great Powers. *Hinc illæ lacrimæ.* With our earlier rivals—the French—a sensible agreement was made which at the moment is responsible for our command in Egypt and Suez. But the later rival was only piqued by jealousy of Great Britain. There was always a grasping and hectoring tone in Prussianized Germany, and in the Nazi regime that temper has been aggravated by the foulest stream of cruelty and lying which history relates.

The result is that, with the exception of Japan, all the threatened and occupied nations rally to the champions of world freedom. But they are at the moment helpless and the United States of America, the U.S.S.R. and Great Britain have to face the threat and restore the world.

Here Mr. Muirhead is favourable to us, though earlier in his book one might think a British conqueror or settler no better than he should be. Clearly

the settlement of stronger people among the uncivilized must lead to friction. But an honest narration of the facts makes it clear that Britain civilized, and is far the best colonizer in the world. The Dutch have worked well with us in the now most contested part of the front.

Mr. Muirhead is quite clear that we shall win, or at least that Germany must lose: "the financial and economic scales are too heavily loaded" against her. But the task before us—perhaps for some years—is the restoration of order when the Nazi chain is broken. For this purpose the Atlantic Charter strikes the note. In the post-war world there must be some international authority, and Mr. Muirhead would be content if we did the policing. He sketches a scheme of free-trade roads which would enable the smaller nations to trade and to gain their own necessities without the loss and vexation which attend the present system. We wish such a plan well, but before that we have to break the hideous yoke which has been imposed by the Nazis until they reached the barrier of Russia.

It is a long and determined struggle and we need to keep something of the crusader, with all the fire and finish of modern war. It is to be hoped and believed that the United Nations will perform it.

F. S. MARVIN.

THE 'CELLULOSE AGE'

An Introduction to the Chemistry of Cellulose

By J. T. Marsh and Dr. F. C. Wood. Second edition. Pp. xv+512+24 plates. (London: Chapman and Hall, Ltd., 1942.) 28*s*. net.

THE influence of chemical research on the industrial applications of cellulose has in general been slow in making itself felt as compared with results in many other industries. This, perhaps, is due partly to the fact that the cellulose industries have hitherto been regarded primarily as the domain of the engineer; although a contributory and more likely reason is the complexity of the chemistry of cellulose. It is not surprising, therefore, that the important advances in this branch of chemistry which have taken place during the past twenty-five years are putting cellulose on an entirely new footing as a material of industry, and it may well be that the post-war period will herald a 'cellulose age' marked by many varied and interesting developments of a chemical rather than engineering nature.

Several weighty arguments justify this view. First, as Cross and Bevan wrote in 1895, "cellulose is the predominating constituent of plant tissues, and may be shortly described as the structural basis of the vegetable world". The industrial applications of cellulose are therefore, like agriculture, a direct link between man and the plant world. Secondly, the achievements and possibilities of the cellulose industries are impressive in both magnitude and scope. Thus what may be described as the primary cellulose industries, such as timber, textiles (including rayon) and paper, are all essential features of modern civilization, as war-time shortages have demonstrated only too well; while the secondary industries and their ramifications, though still in their infancy, cover an extremely wide field ranging, for example, from the plastics, fine chemicals and organic solvents derived from the waste liquors of the cellulose pulping processes, to the explosives, cattle fodders, sugars and other fermentation products obtainable directly from cellulose itself. There are many other examples.

It is not to be inferred that this volume covers all the fields indicated above; that it should result in reflections of this nature, however, is a measure of the importance of its subject and of the success of the authors, as well as the fullest justification for its existence—if justification is needed for a second edition which appears within three years of the first. The authors certainly have again done their work very well and have presented an up-to-date résumé of the subject, despite the great handicap of the rapid development of our knowledge in this field. This handicap is strongly apparent when, for example, the molecular weight of cellulose is considered; six different methods of determination are described, but the values obtained show marked variations, and this applies both to cellulose from the same source and to the results of different workers using the same method.

In this connexion there are occasions when the reader feels that he would like a little more critical comment from the authors themselves on contradictory results rather than bald statements, however accurate and concise, of the work of others; this is important in a book dealing with such a difficult subject, and intended (as the preface states) primarily as a guide to the younger chemist entering the cellulose industries. On the other hand, if the book is judged mainly for its value as a summary of current knowledge on the subject, it is impossible to praise it too highly. Little work of importance has been overlooked, and some of the few omissions (such as the convenient cupri-ethylene diamine reagent for the determination of the viscosity of cellulose) are probably the result of the long time-lag between publication and 'publicity' which exists at present.

Those who, like the reviewer, incline to the wider view of the importance of cellulose will be a little disappointed at the bias shown towards textiles, and in particular to cotton cellulose. Thus, for example, wood pulp (which may contain more α-cellulose than cotton and is the basic material of large sections of the rayon and paper industries) receives little mention, and then only in passing. Again, while the chemical and physical properties of cellulose are fully discussed, the effects on these of mechanical action (such as the beating operation in paper manufacture) are not referred to; yet they make valuable contributions to problems such as the structure of cellulose fibres, including those of textile origin. A chapter dealing with this very important aspect of the subject would certainly be a valuable feature of future editions. This, however, is a personal opinion, arising possibly from an opposite bias to that of the authors, and it in no way precludes the reviewer from confidently recommending the book to all concerned with cellulose as well as to the 'ordinary' chemist.

It is necessary only to add that apart from the discussion of the constitution and structure of cellulose at an earlier stage, the general scope and arrangement of the material are the same as those of the first edition. There are, however, some eighty additional pages and several extra illustrations. Misprints noted in the first edition have been corrected, but a few more have crept in, and some of the abbreviations used for references (for example, B.C.I.R.A. and J.T.I.) will probably be meaningless to many readers and do not occur in the explanatory list at the end of the book. The standard of production shows very little deterioration from that of pre-war times.

JULIUS GRANT.

Tin Solders

A Modern Study of the Properties of Tin Solders and Soldered Joints. By S. J. Nightingale. (Research Monograph No. 1.) Second edition, revised with inclusions of Results of more Recent Research, by Dr. O. F. Hudson. Pp. 118. (London: British Non-ferrous Metals Research Association, 1942.) 10*s*. 6*d*.

OF all the common alloys used by the engineer, solder is by far the most expensive. Further, as a result of the temporary loss of the main tin-producing area in the Empire, the utmost economy in the utilization of this metal, an essential ingredient in most solders, is imperative. The present time is, therefore, particularly appropriate for the publication of a second edition of a valuable little compilation which has been out of print for some time.

In its new form, this volume contains considerably more information than did the first edition, particularly in connexion with the metallography and properties of these alloys, and it speaks well for the excellence of the first edition that the part which deals with the more practical considerations and the choice of a suitable solder has required practically no modification.

As one example of the utility of this book, both from the point of view of the information it gives, as well as from that of economy of tin, may be instanced the solder used for production of wiped joints in electric cable sheathing. An earlier specification for such material required about 35 per cent of tin with not more than 0·5 per cent of antimony. It has now been found that an alloy with 30–31 per cent of tin which may contain up to 6 per cent of antimony has superior mechanical properties, gives joints of reduced porosity, and, in the experience of the workers, is easier to manipulate.

Dr. O. F. Hudson, the new editor, and the publishers have done a very useful piece of work.

A Supplement to the Yorkshire Floras

By the late F. Arnold Lees. Edited by C. A. Cheetham and Dr. W. A. Sledge. Pp. v+134. (London and Hull: A. Brown and Sons, Ltd., n.d.) 6*s*. net.

THE flora of Yorkshire has been described in the volumes on West Yorkshire by F. A. Lees (1888), East Yorkshire by J. F. Robinson (1902) and North Yorkshire by J. G. Baker (1906). Some thirty years ago, Lees collected the additional records and incorporated them in a manuscript entitled the "Vegetation of Yorkshire and Supplement to the Floras of York". This extensive manuscript included, however, so much theoretical discussion relative to the facts embodied that sufficient support could not be found for its publication, though the Yorkshire Naturalists' Union always hoped that the included records might be made available for botanists. This undertaking has now been achieved by Mr. Cheetham and Dr. Sledge and published under the auspices of the Union.

Mr. Cheetham has a very wide knowledge of the flora and has been connected for so long with all aspects of the work of the Union that no one could have been found better able to undertake the work of extracting all reliable data from Lees's manuscript and from the records of the Union. Dr. Sledge has added very many recent records and has revised all the material in the light of the most recent developments in nomenclature and grouping of genera. The volume includes a complete list of the recorded species, including aliens, casuals and escapes which are distinguished typographically from natives, with new recorded localities and points of interest concerning changes in distribution. This cheap and relatively small volume does great credit to the amount of work put into its preparation in order to condense the material to valuable essentials.

The Observer's Book on Astro-Navigation

By Flight-Lieut. Francis Chichester. Part 4. (Observer's Books, No. 5.) Pp. 152. (London: George Allen and Unwin, Ltd., 1942.) 4*s*. 6*d*. net.

IN this, the fourth and concluding portion of Flight-Lieut. Chichester's book on astro-navigation, a number of important matters are dealt with. These include a description of the flying-boat sextant and the errors that can be introduced into the observations by flight accelerations. The advantage of taking a number of observations at short regular intervals is shown and a brief description is given of the median-marking sextant. The aid to navigation given by running down a position line, when the sun is the only object available for observation, is illustrated by the record of observations on an actual flight; the method is of special value for flights over the sea, where no landmarks are available for fixing position. The important subject of curved flight corrections is dealt with in some detail. If accurate navigation is required, it is essential to apply corrections for curved flight, due to the rotation of the earth, or to the course steered not being a great circle, or to gyro-wandering. The account of these corrections is somewhat confused, though the method of applying them is clearly explained and illustrated by examples.

The four parts of this book together provide a useful summary of the principles and methods of astro-navigation. Written by a skilled navigator, they contain many practical hints, and any navigator who has mastered their contents cannot fail to benefit from them. H. S. J.

The Subject Index to Periodicals, 1940

Pp. xi+230. (London: The Library Association, 1942.) £3 17*s*.

THE Subject Index of Periodicals, 1940, issued by the Library Association, publication of which has been considerably delayed by enemy action, covers 534 periodicals, other than those, with some important exceptions, covered by the *Agricultural Index*, *Engineering Abstracts*, *Engineering Index*, *Index Medicus*, *Journal of the Society of Dyers and Colourists*, *Photographic Abstracts*, *Bibliography of the Royal Meteorological Society*, *Science Abstracts*, *Journal of the Textile Institute*, and the *Revue des Géologie, Minéralogie et Crystallographie*. The number of entries has been diminished owing to the curtailment of the supply of Continental periodicals since 1940, and some of the files of American periodicals are also incomplete. The volume, however, is only about one sixth thinner than the normal volume. The Index is compiled on the plan of the dictionary catalogue, articles being entered under specific headings, in alphabetical order. Explanatory matter is added in square brackets where the titles do not sufficiently indicate the subject of articles. Since September 1940, the editor and his staff have been accommodated in the National Library of Wales, Aberystwyth, although part of the work still has to be done in the British Museum Library.

MORALE

By JOSEPH GEOGHEGAN

"If thy people go out to battle against their enemy."
1 Kings, 8, 44.

MORALE is a feeling of confidence and competence in the conduct of an enterprise.

This definition needs some enlargement. Morale is a feeling, an emotional state, not an intellectual opinion, and is thus like all emotions a variable; it can be either good or bad. It is a feeling of confidence, confidence in the outcome, confidence in cause, comrades and leaders. It includes a feeling of competence, of personal capability, self-confidence, if you wish. Lastly, morale requires a positive issue, relatively a major one, for the term has no bearing in situations without such an appeal.

Application of the word may properly be made to an individual or to an aggregate of individuals. The latter, however, must possess one definite characteristic, that of being homogeneous in the sense of free association, purpose and sympathy, as in a street crowd, a regiment or a nation. The purport of the following remarks is intended to consider more particularly aspects of morale in the case of the last.

It is important at the outset to recognize clearly that the motivations of a crowd differ radically from those of an individual. The herd instinct, a very strong one, has to be taken into account. While this is active at all times to a slight extent, encouraging behaviour in harmony and consistence with the welfare and custom of the community, it can become, and indeed would appear to be so constructed as to be capable of becoming, a paramount feeling. This is particularly the case in the presence of danger. The ranks close up, there is a reduction of personal individuality, the unicellular organism has, as it were, become part of a multicellular whole.

Furthermore, this effect brings about a reversion to impulse and action of a more primitive type, more of a childish pattern, more of the deeper mind-stuff, the unconscious. The mechanism involved is interesting and pertinent to the issue. The herd instinct operates by an intensive heightening of the suggestibility of all the component units, the people in the crowd. This feature requires emphasis. Suggestibility is definitely outside or beyond the control of the individual and is not necessarily agreeable in any sense with his own interests. It is a simple sharp response immediate and direct to the stimulus of the moment, akin perhaps to a conditioned reflex. The strength of suggestion in a group is very strong; the individual has little or no option but to obey, for it is the emotional side which is employed, not the rational. When the individual merges in the mass his rational mind sinks with him; he ceases to be himself. It is a waste of words to appeal to the intelligence of a crowd; it is only their emotions that listen.

Arising out of, and indeed a component part of, the instinct of the herd is the need of leadership. The pack at all times demands a strong dominant personality in front; in the presence of trial or danger the need becomes insistent and incidentally much more decisive. We then feel the rightness of the right man in the right place with a confidence past question.

With the leader the members of the herd feel a strong identification; he exemplifies in himself the genius of the pack, something louder, coarser, bigger, but something utterly and vividly the presentment of each and everyone. His qualifications are curious; he need have served no long apprenticeship, he need have no particular intellect, but he must have personality and character. He must have the prestige which follows not the reality of achievement but the appearance of it. Finally, he must still be the common man, like the wolf leader, only one jump ahead of the rest. All the members want to see clearly in front the visible embodiment of their own feelings.

After these brief references to certain aspects of the basic material, the factors influencing morale may be considered. Both the physical and psychological sides are involved but the effects of the former are more evident in a detrimental sense.

Factors Tending to Increase Morale

Bearing in mind that morale refers to an emotional tone, the first and probably the most important factor tending to improve confidence and competence in the conduct of an enterprise is *the sense of unity* engendered by the increased contact with our fellowmen, the closing of the ranks. This has both its physical and psychological sides and indeed they are very closely intermingled. In ordinary civil life man is gregarious only in a narrow range, in his work, profession, game, club and so on; in times of danger or distress the need for support, the strength in unity, and vice versa, the insecurity of isolation, converge. They encourage the need for the company of our fellow creatures by the bond created in a renewed community of interest. This fresh warmth of feeling again fortifies courage and fills the individual with a new and special strength. It is the heightening of this impulse which leads to a notable breakdown of social distinctions and local prejudices. Comradeship and the team-spirit are the visible evidence of a common purpose. There is a strong exaltation of both the patriotic and the human sides, all the more so when the combative and aggressive feelings are allowed approved outlet in identification with a greater whole.

This sense of fulfilment in unity gives a new steadfastness and energy to each member of the pack; it increases altruism and tends to add a moral strength to morale. For the national interests so obviously link up with the highest moral aims and purposes of humanity. They are thus strengthened by the indirect appeal to the noblest aspirations of the individual, the conviction of a righteous purpose, the strong association of duty with a deep religious feeling. These feelings may be consciously enhanced by the deliberate inculcation of a high moral aim, by the 'indoctrination' of the public in a sacred fellowship, by the stress laid upon a positive ideal which directly relates national need with a spiritual purpose.

Conversely, the enemy personifies all evil. The same instinct of the herd that brings the ranks shoulder to shoulder for the common good, that gains strength with every fresh evidence of national righteousness, vehemently denies to the enemy any shred of justification. He so blatantly represents the negation of all good, he so deliberately runs counter to every law of God or man, he carries with him such a foul string of barbarities that it becomes only right and proper to smite him hip and thigh. Old Testament phrases come readily to the tongue to express the feeling.

The groundwork for this sense of unity will have been prepared not only by education in the young in the geography and history of their native land, but also by the cultivation of a political philosophy that brings the genius of the nation into the closest relations with the highest ethical principles. Self-defence is not enough, it is too negative; there should have been a long and careful preparation tending to dignify the responsibilities, nay the duties, of the nation with a positive, a moral goal. Phrases such as "England, My England", "this blessed plot, this earth, this realm, this England", the white man's burden, the commonwealth of nations, and so on, become eventually part and parcel of everyday thought, and are accepted as self-evident truisms. It will not, of course, be overlooked that this attitude is by no means the sole prerogative of any one nation; an identical purpose is apparent in the use of such words as Aryan, superman, *Herrenvolk*, *Lebensraum*, etc. The principle has very general application.

Second to this sentiment of unity comes the feeling of *confidence*. This includes many of the relationships of the herd animal, notably so when herd consciousness is stimulated afresh in time of trial. Certain aspects stand out: these are cause, comrades, leaders and equipment.

Confidence in the cause wherein all are engaged implies two angles of approach: confidence in its essential rightness and confidence in its result. The first depends largely upon the depth of that intense emotional feeling we call patriotism; this again arises from a continuity of effects which may be summarized as nature and nurture, which co-operate to encourage the sense of nationality. The famous lines beginning "Breathes there a man with soul so dead" may be recalled to illustrate the passionate association of patriotism with what is regarded as the highest side of mankind. Conversely, from the very strength and urgency of this feeling springs the sharp resentment at the insolence of alien attack. "Ourselves alone!"

This sense of nationality, this patriotism, wells up 'as it were' under pressure from great depths; it is a trained and disciplined emotion, partaking of a certain splendour and assured of a genuine approval. The ground has been prepared not in one but in many generations and needs but a touch to set it all aglow with faith in the right and in the result. Then speaks in no hesitating voice confidence in the high abiding virtue of our cause and the sweet certainty of success. It may again be remarked that there is no material difference between the feeling in Moscow, Madrid, Manchester or Munich.

Confidence is also felt in comrades. This will be at once enhanced by the direct recognition of an equality of service and an equality of sacrifice. The positive evidence of mutual resolve and support, the visible activity on the part of everyone around to the same great purpose, all for one and one for all, encourages the feeling of comradeship and co-operation, which again reacts to strengthen personal endeavour: "Duke's son, cook's son, son of a millionaire" and so on. In service alone can be found peace and satisfaction; if it be denied, discouragement, anxiety and restlessness are felt.

But an equality of sacrifice plays an equal part. The press of conscription on everyone, the fracture of all social distinctions in the ranks, the subordination of the individual pattern in the need to keep step, the acknowledged severity of an income tax that strikes at incomes not at wages, and perhaps most real of all, the daily lists of casualties—names from both the castle and the cottage—bring out afresh mutual trust and *esprit de corps*. Everyone can do his bit!

Confidence must further be felt in leaders and equipment. It will be at once understood that the multiple millions of a modern nation need not a leader, but leaders. There will be many graduations of place and post, all of which have weight and effect. Selection on the part of any section of the public, if allowed free play, will be spontaneous and accurate; it will be natural and will choose a natural leader. Conversely, the capacity to select efficient deputies must be one of the cardinal qualities of leadership.

Equipment again can have decided influence on confidence. The recognition of efficiency to our personal knowledge in the tools to hand, not only the ones *I* use but the ones *we* use, at once improves confidence in every sense. The dark silence of the Navy in the North Sea, the swift and generous issue of gas-masks and the sudden surprise of balloons over London, all had immediate and heartening effect. Like the symbol of the 'tin hat' or the realization of the tremendous technical resources of the United States behind us, they offer additional justification for confidence.

Confidence further extends to the individual in relation to himself and may then be more properly described as a feeling of *competence*, competence in his own conduct in the enterprise. Self-respect and self-esteem at once improve with the search for the personal share, by the genuine attempt to take up and perform serious and important tasks and in particular by their co-ordination with a common effort. Personal ambition is thus brought into the closest association with comrades and country, strengthened by the conviction of moral rectitude, and is directly linked up with the call of duty. This again reacts to strengthen the sense of responsibility and capability which are enobled by self-approval, encouraging the fullest realization of the self in complete alignment with the realization of society.

The personal side is directly increased by the new feeling of place and position, by news in the exploits of one's own or associated groups, by the exaltation of personal bravery and courage, by the evident approval of public opinion and senior officers, by promotion, real or anticipated, by pride in uniform and equipment, by new surroundings wherein one starts as it were from scratch, by the close feeling of linkage with the nobler episodes of national history, and last but not least by the increased and obvious admiration of the other sex.

All three factors tending to increase morale intimately interact. The increased sense of unity with one's fellow-men, the team-spirit of mutual effort, confidence in the righteousness of our cause and the certainty of the outcome, and the fresh zeal of personal ambition, combine to stimulate a high and ardent spirit in the common man.

Factors Tending to Decrease Morale

Interest in the subject of morale has come sharply to the for elargely by reason of the quantity and quality of the numbers actually involved in the conflict. For practical purposes the exposure to, indeed the frequent reality of bombing, turns everyone into a combatant—worse than that, a combatant deprived of the reasonable outlet of an aggressive reply; this involves a high degree of strain. Besides

the quantity, the crude mass of people thrust willy-nilly into this affair, the quality is poor. It is poor in the sense that there has been no calculated preparation for the occasion, none of that assiduous training of both emotion and intellect whereby is created the disciplined unity of the soldier. It is very doubtful if deliberate effort in that direction could be made practicable; more than that it is still more doubtful if it could succeed. The Germans have made attempts by the training of youth and by the distribution of trained agents, but their methods are questionable and their assessment must await future consideration.

Again, the press of warfare fell formerly on a selected portion of the population, selected in age and physique, whose aggressive combative feelings were deliberately led towards an optimum outlet. War took on then for the ordinary adventurous youngster a very satisfactory appeal; it became rather a great game, the greatest of games. But this can no longer describe the situation to-day. 'Total war' has thrust dirty fingers deep into the intimate consciousness of almost every human being, often with a quick sense of acute personal danger. Moreover, it is no longer a short sharp shock calling for gallant bearing, courage and dash; it has become a vehement and prolonged period of tension demanding the deliberate cultivation of a savage resolve.

These are not the days of petty personal vicissitude but of a great upheaval involving directly the selected purposes of humanity. The strain has to be borne by the common man and woman, by loose masses of humanity half developed, half educated, anxious and insecure. Tension so widespread, so severe, so unfair, has brought sharply to the fore visible and unpredictable stresses. It is indeed time to consider and to cultivate morale.

The most important factor tending to reduce morale is a state of *chronic fatigue*. The term is not intended to be used in any restricted sense but is employed to indicate that all-round deterioration of well-being which is brought about by prolonged under-nutrition, by continued insufficiency in the quantity of food and in its quality. Mere bulk of food in no way compensates for a lack of balance and proportion in its components, particularly as regards its freshness. A similar result, though slower in production and less in effect, follows upon long hours of wearisome labour, insufficient or broken sleep, bad housing, bad cooking, bad ventilation. Of these, states of nutrition are the most important for our present purpose. Reference is, of course, intended rather to effects on large masses of the population than in an individual sense, though the latter is more quickly evident and understood.

Adequate, sufficient and satisfactory food is a prime necessity to everyone; a decent meal makes all the difference. Chronic under-nutrition saps the vitality and reduces physical and nervous tone and resistance in a manner akin to prolonged ill-health. It does more; by its appeal to very elementary instincts and needs it creates an urgency tending to override all other considerations. Bread becomes more important than victory; a hungry man will walk up to a machine-gun. Nutrition is further impaired by the other detrimental conditions mentioned. They may be commonplace enough but their incidence is increased in war-time. Their supplementary influence will be readily understood. The consequent ill-effects will be aggravated by psychological conditions encouraging discontent, the blatant evidence of waste, waste in every sense of material and effort, misdirection, reduplication, bad management, personal frictions, distrust and ridicule. But it is probable that the merely physical has the more lasting and more severe effect.

Fear is another important factor causing deterioration of morale. It is related to fatigue, but the former tends to be primary; in states of chronic fatigue fear will the more readily arise, but states of fear do not produce the same fatigue effects.

Conditions responsible for fear in one form or another are, of course, manifold, but there is one the importance of which cannot be over-rated; this is isolation. Under strain and stress swiftly follows an intolerance of solitude, physical or mental. The need of the mere physical contact with our fellow-men is very urgent, and if frustrated or hampered brings about restlessness, impatience and anxiety. While this applies of course to the individual, it plays an important part in the group-mind. The knowledge of friends and allies who are near, able and willing to help, strengthens purpose and confidence by the feeling of support. Isolation, real or apparent, produces or aggravates manifestations of insecurity and impotence, and thereby sensitizes the fear-sense.

Fear has several forms; panic is a "gigantic and senseless dread", apprehension is a continuing anticipation of danger, and fright involves surprise or sudden shock. The effect of mere noise may be here remarked on; this is a primitive fear stimulus, evident in all the preliminaries or actualities of combat from the roar of the lion to the trumpets of a mighty host. The present War is unpleasantly noisy, though the stimulus would not appear to have been deliberately sought by either side. Another point which may be referred to is the production of acute states of fear or shock, the so-called 'shell-shock', and of chronic states of anxiety by continuous recurrence of slighter degrees of very genuine strain against which there is neither defence nor reply.

An index, useful as a rough guide to the extent of fear in a given population, is found in the prevalence of rumour. The stimulus of fear, not necessarily of danger, sensitizes the collective mind, so that an attitude arises swiftly credulous of information reinforcing and fortifying this emotional tone. The degree of fear, more particularly of apprehension, and conversely the degree of confidence, will be reflected in the prevalence or otherwise of rumour. No such situation arises, of course, unless the gravity of the threat be considerable, but that alone does not suffice, a heightening of fear must be added. The same attitude explains the unfounded suspicions of 'fifth column' influences recurrent in a timid, distrustful, over-anxious population. These indicators are worth watching. Apparent lack of progress, even news of serious setbacks, has little or no effect upon a population whose tone is good; for example, the reaction in England to the sinking of two battleships and the loss of an army in Singapore.

Inertia and depression manifest themselves as a result of monotony or inactivity. Just as privations lead to fatigue, and danger, real or imaginary, to fear, so the persistence of long wearisome hours, lack of interest, lack of variety, of change, bad weather conditions, night-work, black-out, home-sickness, distasteful associates, and in particular monotony, monotony which appears to serve no useful purpose, lead to a degradation of moral or physical energy which calls for special remark. There is a loss of sense of proportion, a pre-occupation with oneself,

a lack of interest in and capacity for work, a depression of stamina.

Periods of inactivity, complete or partial, when circumstances refuse any reasonable outlet of energy, particularly useful energy, is another form of monotony having similar effect. It is important to recognize that change and variety of occupation and interest represent for human beings a form of rest, physical and mental. The Germans take this point seriously, encouraging frequent holidays and strenuous physical exertion on the part of higher officials.

As in the case of those tending to improve morale, factors of a deteriorating nature may well be multiple and indeed often are. They then tend to exaggerate the respective reactions. States of chronic fatigue from one cause or another clear the ground for fear and depression; conversely, situations likely to produce the latter will aggravate the unpleasant sensations of fatigue.

Conclusion

Morale, more particularly in its national aspects, requires serious attention. The problem in the case of the disciplined soldier is much easier, something concrete has been prepared to work on; it is a very different matter with the shifting unstable masses of a civil population exposed to novel and dangerous stresses. The strain is not merely physical; all sorts of real and imaginary threats hang darkly upon the horizon, stripping away ancient securities and landmarks.

It will not have escaped notice that some, at any rate, of the factors concerned with morale can be directly influenced by deliberate effort, by taking thought. Such effort need not solely derive from authoritative sources but should reasonably come within the province of every responsible person.

Both sides in this Second German War—this Second Punic War—have advantages and disadvantages. The stability and resolution of the Allies may be set against the plasticity and discipline of the Axis peoples. That on the whole the balance would appear to favour the former need not encourage neglect of a factor of increasing, perhaps ultimate, importance.

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WILD LIFE IN THE WESTERN HIGHLANDS*

By SETON GORDON, C.B.E.

THE War has little affected the Western Highlands. It has, of course, been in the favour of those animals and birds which are sometimes classed as vermin. But I think that this is a narrow-minded and repellent term, given by those whose lives were formerly devoted to the care (and then the destruction) of the red grouse.

This is the third early summer season that the Highland deerstalker and the Highland gamekeeper have been on 'active service', and the most noticeable result of this absence is the spread of the fox. The fox has now become a menace to crofters and sheep farmers in a number of West Highland districts. More than forty lambs were killed last spring near us in Skye.

The wild cat is also on the increase, although not to the extent that might have been imagined. A deerstalker wrote that he recently found the carcass of a wild cat at a golden eagle's eyrie. There must have been a great fight before the eagle was able to kill the cat—unless indeed the King of Birds had happened to come upon the cat asleep. I have visited many eyries of eagles, but I have never seen a wild cat brought as prey, although I have seen the remains of a stoat more than once. A deerstalker once described to me a tremendous onslaught by a golden eagle upon a wild cat. The eagle swooped on the cat thirty or forty times, with its great talons ready to grasp it. Once, as the eagle came very near, the cat sprang into the air, striking at the eagle with its claws. The spring was so great a one that the stalker saw the whole of the cat for a second suspended in mid-air.

During the month of May, some years ago, my wife and I had a 'hide' at a golden eagle's eyrie on a rock up a lonely glen. We stayed with the stalker in the only house in the glen, and from the stalker's house to the eyrie was a distance of two miles or more. There was a blackbird living near the stalker's lodge. One night my wife had taken an all-night watch in the hide. Eagles sleep very late (for birds) since there is no necessity for them to search for the early worm, and the birds and beasts on which they prey are not usually in evidence until the sun is well up. The blackbird had taken a flight far afield that morning, and before sunrise flew up and perched in the small rowan tree that grew beside the eyrie. Here he began to sing and his song awakened the sleeping eagle on the eyrie. The eagle aroused herself, and glared balefully at the blackbird, which at once flew off to more healthy surroundings.

In the West Highlands is a high cliff where a pair of eagles and a pair of ravens nest. It is astonishing how hard the eagles are mobbed by the ravens, which attack them in the air for half an hour at a time. The ravens have to fly at their topmost speed to keep in touch with the eagle during its downward swoop. The eagles very occasionally turn half-heartedly upon their persecutors, but for the most part treat the attacks with indifference. Only last week I saw this eagle attacked previously by a pair of kestrels. Upon occasion I have seen two eagles attacked in the air by a single raven. Golden eagles do not often nest on cliffs beside the sea. I have seen one eyrie in this site, and the ground at the head of the cliff was honeycombed with rabbit burrows, so that the eagles had not far to fly for food for the two eaglets in the eyrie.

Near that eagle's eyrie is a colony of fulmar petrels. In the British Isles the fulmar is increasing to a remarkable extent. In the year 1878 there was only one colony in Britain, and that was on distant St. Kilda, an island group lying some fifty miles west of the Outer Hebrides. Whether the surplus stock originated on St. Kilda itself it is impossible to say, but at the present day the fulmar nests along the coast of Sutherland and Wester Ross; it has established colonies upon Skye and the Outer Hebrides; upon Mull and the small islands lying to the west of Mull. From Mull, or perhaps from Barra Head, it has spread to

* Substance of a lecture at the Royal Institution on May 29.

Eire, Wales, and even the coast of Cornwall. On the east side of Britain it has spread from the coast of Caithness, by way of Berwick, to Northumberland, and even to Yorkshire beyond. When it is realized that the fulmar lays only one egg in a season, and may not even lay each year, this increase is one of the most remarkable things in the history of British birds.

The common bumble bee is found throughout the West Highlands. It is a strong flier, and I have met with it crossing the summits of the Cuillin range in Skye. From personal observations I know that there is a flight-line of these bees between the mainland and the Isle of Skye across the Sound of Sleat, a distance of some five miles. From observations I believe there is also a flight line, in fine, calm weather, from Hunish, the most northerly point of Skye, across to Lewis, a distance of some twenty miles. Bumble bees are strong fliers and I remember only on one occasion seeing them defeated by the power of the wind. I was crossing a long line of cliffs in northern Skye and although the sun still shone the south-east wind was increasing to gale force. The wind struck the cliff, which threw the body of fast-moving air high into the sky. This proved an impassable barrier to the bees. Again and again they essayed to fly out over the cliff, and each time were tossed high into the air and swept back, to fall on the heather in the zone of relative quiet behind the cliff. Here bumble bees were to be seen crawling, exhausted, on the ground. The season was September, when the nights are long and cold, and I often wondered what the fate of these storm-beset bumble bees was.

WHAT THE PLANT DOES WITH ITS MATERIALS*

By DR. HUGH NICOL

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PLANTS build up a large variety of organic substances. The aromatic compounds of plants include several anthracene derivatives, such as the principles of madder and of senna, but scarcely any naphthalene compounds are known: vitamin K is one of these. Most of the organic constituents of plants are formed of carbon, hydrogen, oxygen, nitrogen, and occasionally phosphorus, sulphur and selenium. No organic halogen compounds have been found in the higher plants; there is no sound evidence that iodine or bromine is necessary for plants, nor is chlorine apparently essential.

In plants few types of organo-metallic derivatives have been extensively investigated; of these, chlorophyll is the best known. Phosphorus occurs in organic combination in phytin and some other substances. Calcium occurs as pectate and organically bound in agar, yet, generally speaking, the bases are best known in combination with simple organic acids. Iron is essential for plant growth, but beyond saying that it is indispensable for the production of chlorophyll, into the composition of which it does not enter, there is not much that can be said about its role in the plant; nor, except about a very few elements, can much be said regarding the combinations of elements in plants or about the function of their compounds.

* Substance of a lecture given before the London and South-Eastern Counties Section of the Institute of Chemistry, at the Institute on April 15.

Plants have been shown to require, for their proper development, minute amounts of what the agronomist calls 'trace' or 'minor' elements, meaning thereby elements which until recently were not regarded as necessary, or were even regarded as toxic. The list of necessary elements is now long and is growing. The success of grain formation in cereals grown on some copper-deficient soils of Australia depends upon the uptake by the plants of a few grams of copper per acre. Water from a copper still usually contains enough copper to be toxic if the water is employed for solution cultures; the essentiality of copper is thus a matter of micrograms rather than of milligrams per plant.

The discovery of boron as an essential element for many plants originated in the circumstance that at Rothamsted Experimental Station there was an entomologist who wished to make bean plants distasteful to the black 'fly' (aphis) which he was studying. The Botany Department supplied him with some formulæ for water-culture solutions to include several unusual elements of which boron was one. All his plants died except those which had been given boron. This was in 1921. The matter was looked into, and in 1923 Dr. Katherine Warington published the proof of the need of the broad bean for boron[1]. It is not given to everyone to found a minor industry with her first piece of research, yet this, in effect, happened in her case. Not only has the agricultural consumption of boron compounds attained considerable dimensions but also the importance of salts of copper, manganese, zinc and other elements as manurial constituents is increasing.

The necessity of zinc for pecan trees on the copper-deficient soils of Florida was discovered owing to a copper solution having been made in a galvanized bucket; only trees treated with this solution (which unintentionally contained zinc) responded[2]. An interesting effect of minor elements was also reported from Florida, where orange trees treated with minor elements in addition to the usual fertilizers suffered much less frost damage than did those receiving customary manuring. This offers an example of the dependence of 'condition' upon nutrition. Some minor elements are important for animals though not essential for the herbage plants, which function simply as vehicles. The uptake of cobalt offers an outstanding example of dependence of animals on the soil via the plant.

Plants can be selective in their uptake of elements. There is geochemical interest in the concentration of mesothorium by a pond plant[3]. From the point of view of essentiality and uptake, one of the most interesting elements is selenium. Its physiological role has been recognized only in the last decade, owing to the investigation of seleniferous soils. These soils have only a small selenium content, but cover vast areas in North America. Marco Polo recorded poisoning of animals in China which has since been shown to be referable to a seleniferous soil. A similar condition in Ireland remains unexplained[4].

In their reactions to selenium, plants can be divided into four groups: those which require selenium, those which can tolerate large amounts in their tissues, those which can tolerate small amounts but are poisoned by large amounts (these include crop plants such as wheat), and those which practically exclude it. The last group comprises some native prairie grasses. The first group is formed by some species of the botanically varied genera Astragalus, Oonopsis and Stanleya; for these selenium is an

essential element, and the concentration in the dry matter and in the seed may surpass 3,000 parts per million. Recently an amino-acid complex containing both selenium and sulphur has been isolated from grain and from Astragalus[5].

Plants for which selenium is essential, such as certain species of Astragalus, will, of course, grow naturally only on seleniferous soils (the converse does not hold). Hence they serve as an interesting introduction to the subject of 'indicator' plants—that is, plants which by their presence or mode of growth indicate soil conditions. The medieval discovery of alum in Italy and the establishment of its manufacture as a Papal monopoly are said to have originated in the finding at Tolfa of a plant supposed to be the same as one which grew near the older alum mines of Asia Minor[6].

The plant's raw materials are all very simple chemically; unlike the animal, the plant is not adapted for the assimilation or digestion of complex foodstuffs, and if complex materials are presented to the plant they must first be broken down by bacterial or other action before the plant can take them in. The chief role of the soil is to serve as the nidus for such decompositions: weathering for the breakdown of minerals, biological decomposition for the breakdown of plant remains and other organic matter. An important product of decomposition both in the soil and in the tissues of living organisms is carbon dioxide. The only recognized sources of carbon dioxide and indeed of carbon for the plant are the atmospheres above and in the soil.

Pliny referred to the product of respiration as *spiritus letalis*, but it would be truer to call carbon dioxide *spiritus vitalis*. The application of radioactive tracer carbon has shown that reduction of carbon dioxide is a general property common to all living cells, and has led to revolutionary ideas regarding the mechanism of the photosynthesis of sugars in the insolated plant. The initial step in the assimilation of carbon dioxide by photosynthesizing cells is a dark process independent of light. The first intermediate in photosynthesis has been isolated and has been partially characterized as a large molecule of molecular weight about 1,000, having a free carboxyl group and an alpha hydroxyl group. This is supposed to be an enzyme or a prosthetic group of an enzyme and it reacts like this:

$$RH + CO_2 = R\,COOH: \text{ dark reaction,}$$

in which RH is the reduced enzyme group. The light reaction or photochemical step then occurs:

$$R\,COOH + H_2O \xrightarrow{\text{chlorophyll}} R\,CH_2OH + O_2$$

R CH_2OH adds another CO_2 and the process is repeated to build up long carbohydrate chains[7]. Green plant photosynthesis is only a special case of the general biological phenomenon of dark carbon dioxide reduction.

All plants, even those inhabiting arid regions, are very wasteful of water. For every ton of grain or of dry matter produced, several hundred tons of water are passed through the plant and are discharged as vapour into the atmosphere. The remaining elements are mainly assimilated through the roots, though some for which the plant has only a small requirement can be absorbed through the leaves and stems. Plants are ionic feeders, and they need their ions as simple as possible.

That the plant is not a homogeneous absorbing system is shown by experiments with roots divided between nutrient solutions of differing composition, whereby corresponding differences are produced in the tops. Dr. John Caldwell has suggested that plants having decussate phyllotaxis lend themselves to neat demonstrations of this inhomogeneity, as when half the flowers of a hydrangea plant were red and the other half blue.

Asymmetry in absorption is well shown by the observation that swedes in the field develop better on the south side than on the north. Here are some averages, after Caldwell[8].

TABLE 1
RADII IN MILLIMETRES, OF QUADRANTS OF SWEDES

Rows running	N	S	E	W
E–W	49·5	58·5	50·9	59·5
N–S	44·5	50·8	46·5	49·5

This is due to differential assimilation by variously insolated leaves.

Intake of nutrients through roots takes place in three ways: direct absorption of anions and cations through the finer roots and root hairs; absorption or exchange of nitrogenous compounds from nodules attached to the roots of many leguminous plants; indirect absorption through the medium of fungi which together with the roots form what are known as mycorrhizæ. Recent knowledge about roots has given new perceptions about their extent[9]. T. K. Pavlychenko has measured the roots of single prairie grasses grown free from competition of other plants and has recorded more than three hundred miles of root belonging to a single plant three years old, while a single plant eighty days old had fifty-four miles of roots of first and second order alone. A young plant may have a net gain of the order of one mile of root daily. Roots are neither permanent, as a rule, nor static. The finer roots of a living plant are constantly being shed, and thus are taking part in the cycle of decomposition in the soil. W. S. Rogers[10] has demonstrated the impermanence of roots of such a substantial plant as an apple tree. Within a few weeks apple rootlets have been observed to grow and decay, fresh ones being formed meanwhile in the same region of soil.

There is a balance between the amount of root and the amount of top. By cutting the tops of a plant—say, by mowing the lawn—the roots are also trimmed. (Table 2.)

TABLE 2
DRY MATTER PRODUCTION, IN GRAMS, OF LUCERNE CUT AND NOT CUT[11]

Tops	July 6	July 27	Aug. 24
Unclipped	10·4	17·7	20·4
Clipped once, July 5		18·5	
Clipped twice, July 5 and 26			24·5 (clippings included)
Roots			
Unclipped	5·8	16·5	24·1
Tops clipped once		10·3	
Tops clipped twice			16·0

A closely cut lawn suffers during a drought because the diminished roots are not able to reach the soil moisture in the deeper layers.

Roots are not merely absorbing organs; they are also reserve organs. The relation between tops and roots has important practical consequences, since if perennial forage plants and grasses are cut or grazed too closely in late autumn they will not be in a good

condition to survive the winter or to make early growth in spring, on account of the lack of sufficient reserves in the roots. Nitrogenous manures applied in spring are no substitute for adequate over-wintering root reserves.

Leguminous plants may possibly excrete nitrogen fixed by the aid of their associated nodule bacteria, and may thus act as nitrogen 'foster-mothers'. The dynamics of the plant include several modes of return of absorbed material to the soil. The most obvious in perennial plants is leaf-fall.

A more interesting mode of return of nutrients to the soil is apparently common to annuals and perennials. It is what the Rumanian worker N. T. Deleanu has called *Rückwanderung*. The demonstration of this process is not very simple with modern data, but the work of J. I. Pierre in the 'sixties is of interest[13]. Table 3 shows amounts of some elements present in the whole wheat plant.

TABLE 3

KILOGRAMS OF CONSTITUENTS IN A HECTARE OF WHEAT (WHOLE PLANT INCLUDING ROOTS). (AFTER J. I. PIERRE, 1863.)

	June 13	June 29	July 13	July 30 (harvest)
Total organic matter	5400	6500	6900	6800
N	76	76	68	70
SiO_2	191	252	214	228
Fe_2O_3	15	30	17	19
CaO	44	45	44	36
K_2O	39	55	34	34
P_2O_5	18	19	18	23
,, in ears	2	4	7	17

There is a maximum of richness a month before harvest; the only constituent that goes on increasing is phosphorus in the ear. While possibly some of the potassium is washed out by rain, it seems that part of the early stock of nutrients has been returned to the soil. Plants can absorb ions from true solution, but the soil solution theory is unable to account for *Rückwanderung* or for what has been called contact depletion.

The ideal soil is not composed of discrete mineral grains, but of crumbs or aggregates. These include colloidal matter of two kinds—mineral colloids and organic colloids. The latter may be partly humus, which may be regarded as an *end-product* of the microbial decomposition of organic matter. In a fertile soil the organic matter includes a sticky material less inert than humus, and resulting from the recent decomposition of organic matter[13]. This organic cement sticks the grains together into small crumbs which have the most desirable physical properties. It is not the microbes which are important in soil, but the products of their recent activity are important.

There is reason to believe that the plant and the soil with which it is in contact form a practical continuum. This contention gains weight from the work by H. Jenny and R. Overstreet on ionic exchange. If plants are grown in mixtures of sand and calcium clay, the roots accumulate calcium ions, whereas the clay particles gain in adsorbed hydrogen ions. Contact exchange is postulated to take place only when the (cation) oscillation spaces of particles overlap: the particles may be both clay, or one may be a root surface, both being negatively charged. Contact intake is difficult to investigate on account of a presumed high gradient of carbon dioxide in the neighbourhood of a root, but there is very suggestive evidence of contact depletion, so that the theory of contact exchange of ions may be regarded as having made a promising beginning. There is yet no evidence for contact exchange of anions. No contact jumping of cations could be found between roots and positive iron hydroxide sol[14].

The disposition of materials by plants is a highly dynamic and largely cyclic set of processes. There are, of course, wheels-within-wheels: short-period cycles as well as long-period cycles. The broad cyclicity of nutrients is well shown in the tropical rain forests, where most of the nutrient stock remains, and the greater part of the nutrient cycle takes place, *above* the ground. In cool humid climates the cycle is impeded, and valueless plants such as heather constitute the type vegetation. The ideal agricultural soil is one in which the cycle is fairly shared between soil and plant. Artificial modifications in pursuit of the full roundedness of the soil/plant cycle are the purpose of man's operations in cultivation and manuring.

[1] *Ann. Bot.*, **37**, 629 (1923).
[2] Sci. Sect., Natl. Paint, Varnish and Lacq. Assoc., Circ. No. 446, 607 (1933).
[3] NATURE, **140**, 317 (1937).
[4] *J. Roy. Agric. Soc.* (Ser. 3), **1**, 384 (1890).
[5] *J. Amer. Chem. Soc.*, **62**, 234 (1940); *J. Biol. Chem.*, **139**, 649 (1941).
[6] Mellor, J. W., "Treatise on Inorganic Chemistry", **5**, 149 (1924); *Chem. and Industry*, **11**, 156 (1933).
[7] *J. Amer. Chem. Soc.*, **63**, 3443 (1940); *Chronica Botanica*, **6**, 337 (1941).
[8] *Proc. Roy. Soc. Edin.*, **50**, 130 (1929).
[9] *Amer. J. Bot.*, **24**, 417 (1937); *Canad. J. Res.*, **15** C, 33 (1937).
[10] *J. Pomol. Hort.*, **17**, 99 (1939).
[11] *J. Agric. Sci.*, **24**, 532 (1934).
[12] See *Agric. History*, **10**, 2 (1936); *Chem. and Industry*, **14**, 560 (1936).
[13] *Soil Sci.*, **49**, 1 (1940); *J. Amer. Soc. Agron.*, **32**, 204 (1940).
[14] *Soil Sci.*, **47**, 257 (1939).

AD ASTRA*

By THE RIGHT HON. LORD BRABAZON, P.C.

I THINK I am speaking the truth when I say that those who were responsible for the birth of flight thought of it as a new force in the world for peace, for prosperity and for true internationalism. Here was to come something which would make the world a happier place by a quick form of transport, that would bring us all closer together. It was for that idea that I saw my friends pour out their meagre fortunes in experiment, and risk their splendid lives in brave endeavour. I contend that the crushed, shapeless or charred embers of so many victims were well sacrificed, if they were to bring about such ideals. But mechanical science outstrips human wisdom, until we find we have created a juggernaut that may indeed destroy us. I want it clearly realized that if to-day flight bears the brand of Cain, it is not on the pioneers that the blame should be laid, but on foolish politicians of many countries.

Holt Thomas must bear an honoured name in trying to use war aircraft for civil purposes, with resultant commercial disaster. The Government stepped in with half-hearted support to an enterprise which meant so much to a far-flung Empire, but so lacking was vision that the only thing ever indulged in was puny assistance to civil aviation and, on the military

* Part of the Wilbur Wright Memorial Lecture for 1942 of the Royal Aeronautical Society, delivered on May 28.

side, the provision of a few squadrons of aircraft, always at least seven years out of date.

The while Governments were striving after war machines it was left to keen competition in civil aviation in the United States to bring about the first real advance in civil flying. The Douglas is so well known as not to warrant description, but it did promise that at long last the civil side of flying was to go along a separate path in development, and would become divorced from military development. It was later found that as a military bomber the commercial machine was superior to all Government-produced machines.

It has been said by many, and there is much truth in it, that it would be better for us to win the War first before we think and plan for post-war situations. This is one of those half-truths that are so very dangerous, leading one really astray.

The Germans are fighting for a post-war position. We are fighting to resist the imposition upon us and others of an intolerable post-war bondage. Surely, therefore, we both have in our minds the whole time a post-war position. If that is so, there is nothing to be ashamed about or to find deplorable in supposing victory, and to allow one's mind to browse over some of the ameliorations that we should like to see introduced into our beloved country.

The early struggles of flight had not got very far when there came the War of 1914–18. Into that effort there was a tremendous concentration on aviation. For the first time all the efforts of engineers and other men of science were concentrated on the subject with, moreover, unlimited money behind it. It was a mushroom growth not entirely on healthy lines. Field of fire, manœuvrability, lack of blind spots, rate of climb were all points of first importance. Such things as pay load, initial expense, inherent stability, economy of fuel consumption, lack of danger from fire: all those really basic matters that would have come into normal development of a new form of transport were passed by and we were left at the end with certainly a very wonderful advance, but one upon which debate may still rage as to whether the quick growth really helped the science along or retarded it.

I have said that Holt Thomas, trying to use war machines for civil purposes, found that it was an impossibility, so detached from an economic machine had the aeroplane become. Many of us hoped and prayed that a very real divergence would come about between the military type and the civil type. This was not to be, however, anywhere except in the United States, where free competition developed in a country of astronomical distances, which was made for flying development.

All Governments, almost without exception, put their hands upon the aeroplane and said that the State would do this and not allow that. They always saw through a sort of fog also that they must regretfully have at their disposal a nucleus of private firms making aircraft against the necessity of another war.

Civil aviation was born too soon from the bowels of the War of 1914–18 and was mis-shapen from the start, so that it could not, until completely reorganized from a design point of view, *fly by itself*. A vicious circle ensued, therefore, wherein firms wanted to make a civil machine, but as air transport could not pay there were no buyers, and as they had to keep alive they continued making machines that were suitable for war purposes only. Slowly the industry became the tools of the air bureaucracy of their country, who dictated to them what to make. With a lip service to disarmament, actually to keep alive an industry for war, State subsidies started up and down the world nominally to keep flying services going. Take the case, just as an example, of engine development. In all other forms of transport the C.I. or Diesel engine has displaced the petrol engine, for economy in the case of ships and for the buses of London. Notice it was adopted here not entirely for reasons of safety. But in an aeroplane the safety reason was of paramount importance. The statement that I have had given to me, that fire did not matter as most people were killed before they were burnt, is a travesty of the truth, as an aeroplane is never in more danger than when it is not going very fast and is in contact with the ground. Yet did a C.I. engine emerge? No. For this reason: Governments were not interested in it, as it showed no great advantage for war and therefore the manufacturer had no market in which to sell his product if the State-run air-service was not going to encourage such a thing.

Thus history shows that the birth of flight was of clean parents; but due to the War of 1914–18 it was branded with the mark of Cain and ever since it has been tied to the apron strings of Mars. It is a sorry story, and although here and there I and others can point to some cases of honourable endeavour to get away from the position I have described, I think that most fair-minded people will agree that what I have said is the truth.

Is there to be such lack of imagination, such supineness, shown in the world again? I feel it only right that we should consider this problem while we are under stress and strife, and plan and arrange the future. Otherwise I know that it will pass to a tired and poor post-war world with little energy or imagination, only wanting to be left alone to lick its wounds.

I take it first of all as axiomatic that those nations that have fought together and suffered together, and won together, are going to remain friends and work together. What is curious, however, is that most of these nations are, above all, nations that are concerned with very long distances as the basis of communication. I suggest that the United States, the U.S.S.R. and the British Commonwealth, with the United Nations, should announce that henceforth they jointly and solely take charge of all aircraft and all flying, that the *Usque ad Cœlum* (ownership of air above any particular piece of ground) doctrine goes and that in future they give themselves the right to fly whithersoever they like, and that no one anywhere on earth shall fly without their consent. Thus there will be a watching force to see that nowhere in the world shall a nation secretly build up an air force for mischief. This combination will be the start of a Kipling's "A.B.C." It would, of course, delegate to countries their own internal organization for local flying, but always under its broad control. But the great long-distance highways will be in their charge and run by international crews. They will at first operate war machines for intercommunication until better are made by the industry existing, which cannot be dissolved overnight. In return for taking upon itself these great powers, the World Board will guarantee all States against aggression and will constitute to itself the policing of the world. Where we make a difference from the League of Nations idea is that here we will be creating, right at the beginning, a force of transcending power that no one can challenge, instead of a debating chamber that had no force at its command. I do not for one moment lay it down that at the right time our present enemies should not

come into the general scheme. The idea is world co-operation and not penalization. It is high time with the resources at our command that we protected ourselves against a world war every generation. Here in our hands we have the instrument so to do.

A world-wide development of civil flying would have great repercussions on human life and materially improve the standard of living. The exploitation of this great invention to be put to the use of man rather than his destruction is long overdue. The world shrinks in size as time separation diminishes. Mails and passengers would be the first to be served, movement of heavy goods for some time remaining in the hands of the older systems of transportation. What the world holds for us in tariff barriers in the future we do not know, but it is to be hoped that an easier, freer circulation of travellers to and from all countries will be encouraged rather than at present frowned upon by a narrow spirit of nationalism. There are also great tracts of land, rich and climatically possible, waiting to provide a happy life for many, who at present due to lack of communications cannot live there with their kith and kin. With flight our servant, there should be no corner of the earth not readily accessible.

You may say this is post-war planning with a vengeance. To which I reply that there is no one fighting on any front who has not in his heart the idea of a fairer world afterwards where his children and for a time he himself can go about his lawful occasions.

We in Great Britain have seen a revolution take place peacefully in our land over the last twenty years. There is much more to be done. But no amount of planning of our lives and our social progress can be of value or be permanent unless we see clearly and appreciate the potential danger that man has created through the conquest of the air, and so organize the future that it is no longer a threat, but becomes the servant of man. To finish the job we have in hand and then to drift into a fools' paradise would be a tragedy little worthy of the efforts we have made to remain masters of our own destiny.

NEWS and VIEWS

Colonial Policy

MR. HAROLD MACMILLAN, Parliamentary Under-Secretary of State for the Colonies, gave an informative account of the activities and plans of the Colonial Office, in moving the vote for that Office in the House of Commons on June 24. Dealing with the present, Mr. Macmillan said the Allied losses in the Far East mean an immediate and important loss of supplies; 60 per cent of the tin production of the world, 90 per cent of the rubber production, a large proportion of the wolfram and lead, and valuable sources of sugar, tea, rice and oil seeds have fallen to the enemy. Making good the deficiencies will mean an immense increase in Colonial production. In an endeavour to bridge the gap which must occur before large-scale production of synthetic rubber in the United States can be effected, the rubber output of Ceylon has been intensified, the services of Malayan planters have been obtained to assist in reviving plantations in Tanganyika, and wild rubber in East and West Africa is being tapped. Mineral production in the Colonies is being stimulated. The Colonies are also contributing notably to the war effort by decreasing their imports. West Africa is concentrating on the production of rice, vegetables and dairy produce; East Africa is increasing its production of wheat, maize, rye and other foodstuffs. In the West Indies an attempt is being made to introduce more and diverse food crops.

Mr. Macmillan went on to speak of the future. The governing principle of the British Empire must be partnership, he said, and there must be room for the greatest divergence of local responsibility. We must begin now to prepare for changes in the organization of the Colonial Service, with two main objects. First, the civil services and the educational systems of the several Colonies must be so devised that the people are able to qualify for, and desire to serve in, the public services of their own countries. Help would still be needed from outside, however, and this could be provided by a mobile force of experts in administration, medicine, agriculture, finance, etc., at the disposal of the Secretary of State for posting to whatever Colony they are needed at a given time. In this way the present anomaly of the poorer Colonies not being able to obtain the services of the best brains—of which they are actually in greater need than the more advanced and wealthier Colonies—would be removed. Plans are being worked out to achieve this end.

As regards questions of labour and development, Mr. Macmillan remarked that six experienced trade unionists from Great Britain have recently been appointed as Colonial labour officers to British Guiana, Trinidad, Nigeria, the Gold Coast, Sierra Leone and Palestine, to stimulate the growth of trade unionism; and twelve officers from the Ministry of Labour have been seconded for service in local labour departments. Lord Hailey, with the help of eminent men of science, will advise on the organization of research, for which £500,000 a year will be available, on health, nutrition, education, etc., and also on practical economic needs. The Colonial Development and Welfare Act provides for long-term planning, which must be used to assist the Colonies to reach present-day standards of life in the shortest possible time.

THE membership of the Colonial Research Committee referred to by Mr. Macmillan has since been announced. It is as follows: Lord Hailey (chairman); Sir Edward Appleton, secretary of the Department of Scientific and Industrial Research; Prof. A. V. Hill, secretary of the Royal Society; Sir Edward Mellanby, secretary of the Medical Research Council; and Prof. W. C. C. Topley, secretary of the Agricultural Research Council.

Part-time Employment

A PAPER on "Part-time Employment" read before the Royal Society of Arts on June 10 by F. C. Hooper, joint managing director of Messrs. Lewis's, Ltd., describes the inception and working of the part-time scheme of that firm. The details of the scheme were worked out in July and after submission to the Ministry of Labour the scheme was launched by advertisement on August 18. The appeal was addressed to married women of thirty-five and more to avoid the problem of married women with very young children, and particularly with a view to the

rapid release of younger women. Mr. Hooper lays considerable stress on the patriotic appeal, sufficiently so to raise the question as to whether it is right to allow non-industrial industry to utilize part-time labour in this way unless it can be demonstrated that all munition and other essential industrial demands for labour have been fully met. Apart from this the paper lays down a number of principles which are clearly of value in launching any such scheme and which go far to determine success. The regular character of the job and that it is for a fixed time during the day or fixed days during the week, as well as the importance of regularity in time and attendance are impressed on all applicants, and few applicants failed to fit themselves into one or other of the schemes scheduled by Messrs. Lewis's, Ltd. Firm handling of this problem, Mr. Hooper said, has reduced bad time-keeping and absenteeism to a minimum. Much stress is also put on proper welfare arrangements and adequate training, and on the importance of utilizing all the usual means for getting the new employees over the early and most difficult stages of their employment. Accordingly, although a fairly large proportion of the first applicants were lost, fewer really unsuitable applicants are coming forward. Moreover, the firm has been surprised at the comparative ease with which part-time workers have fitted into their administration and at the quality of the part-time workers themselves, the average age of whom was about forty-five.

In addition to the stress on the importance of welfare and personnel work, for which a member of the Board has always been responsible, there is in each business a staff manager with high administrative authority and strictly commercial responsibility, with both a Welfare Department and a Staff Training Department. Mr. Hooper also stressed the extreme importance of explaining the scheme in advance to the management and full-time staff and of securing their co-operation and sympathy. As a result of this handling of the psychological difficulties and the putting out of clear instructions rather than appeals, in no section has there been any real difficulty in employing part-time workers. Two main methods were used. Where work requires verification and constant reference, a team of two or four part-timers work in association with one full-timer. In specialized office work wherever possible part-time workers take individual responsibility for their particular work, the size of self-balancing ledgers and salary books, for example, being reduced so that the workers can complete their work during the shortened hours. This usually works better than a team of two, one morning and one afternoon, being conducive to individual pride in one's work and avoiding the tendency for one half of the team blaming the other for mistakes. All the privileges of the regular staff are accorded to the part-time workers, who are expected to observe the same standard of discipline; the use of the term 'auxiliary' for the part-time staff has also promoted friendly relations and appealed to the patriotism of both.

Drying Blood Plasma and Blood Serum

THE Trustees of the late Sir Henry S. Wellcome have generously placed a sum of up to £20,000 at the disposal of the Medical Research Council for the purposes of research into methods of drying blood plasma and blood serum to provide stable products for use in the transfusion of patients suffering from hæmorrhage, shock, or other conditions requiring such treatment. By agreement between the Trustees and the Council, this gift is to be applied to the purchase, erection and operation by the Council of a plant which will make it possible to test and develop these methods on a substantial scale. The need for the improvement of such methods is of particular importance at the present time, and the products will be made freely available for the treatment of sick and wounded at home, at sea and abroad. The Medical Research Council has expressed its appreciation of this timely and public-spirited action on the part of the Wellcome Trustees.

Dr. Aleš Hrdlička

THE retirement of Dr. Aleš Hrdlička from the curatorship of the Division of Physical Anthropology in the National Museum, Washington, which he has held for almost forty years, is an event which no scientific journal can leave unnoted. Under him there has grown up in the National Museum one of the greatest—if not the greatest—collections of anthropological material in all the world; he is founder and leader of the enterprising school of physical anthropology which now flourishes in the United States. Born in Czechoslovakia in 1869, he was still a youth when his family emigrated to the United States; there he became a student of medicine and it was through the medical portal he entered upon the anthropological problems of the human body. On the anniversary of his seventieth birthday a list of his contributions to anthropology was compiled; they are now more than three hundred in number, covering every aspect of his subject, every one of them making a factual addition to a particular department of knowledge.

Dr. Hrdlička is beyond doubt the most travelled anthropologist of his time; there is no part of the world he has not visited in search of material and of knowledge. He made the circuit of the world several times to examine and report on the fossil remains of early man. His reports, issued from time to time in the publications of the Smithsonian Institution, are recognized throughout the world as the most reliable sources of fact relating to the discoveries of fossil man. His studies on the Old Americans (men and women of British ancestry), of the American Indians and of the Negro population of the United States have become classics. He has sought to trace the first peopling of the New World from a Mongolian homeland in north-east Asia and has explored Alaska for evidence of early migrations. In Alaska, too, he has dug up cemeteries attached to older Eskimo settlements; he has added greatly to our knowledge of the Eskimo, both ancient and modern. Dr. Hrdlička made warm friends wherever he went, particularly in England. He lectured in London in 1939 while on his way to the U.S.S.R. to examine the various finds of fossil man which have been made there in recent years. In 1926 his Czech colleagues issued a "Hrdlička" number of *Anthropologio* in honour of their distinguished countryman. At the close of the War of 1914–18 he founded the *American Journal of Physical Anthropology*, now the leading publication of its kind.

New Zealand Earthquakes

A STRONG earthquake shook a considerable area in New Zealand at about 11.18 p.m. (local time) on June 24. The places most affected were Masterton,

Eketahuna, Greytown and Carterton. Property in Wellington and Palmerston North was damaged. At the southern end of the North Island, therefore, extensive minor damage was done over a wide area, windows being broken, chimneys dislodged and so forth, though no casualties have been reported. Buildings erected since 1933 under the earthquake by-laws (similar to those in force in many parts of California), have suffered only superficial damage. The main shock was preceded by a precursor shock at 8.15 p.m. (local time). The principal shock is said to have been the most severe since February 1931, when more than two hundred people were killed in the Hawke's Bay region as the result of a very severe earthquake. New Zealand is a seismic region, and hundreds of minor shocks occur every year. The study of these, and the multitude of seismological problems which arise, is actively pursued at Wellington, and we await further news of the present shock from the Dominion Observatory.

During March 1942, nine distant earthquakes were registered by the seismographs at Wellington, Auckland, Christchurch and Arapuni in New Zealand, according to the seismological bulletin just received from the Dominion Observatory, Wellington. The greatest appears to have been on March 5, when the ground movement at Wellington was 3 mm. downwards, and the shock is estimated to have had its epicentre some 82° from Wellington with a focus rather deeper than normal. The shock was recorded at Wellington at 20h. 00m. 51s. U.T. Microseisms interfered with the registration and the interpretation of the records throughout the month.

Additionally, 21 local earthquakes were recorded. The greatest was of intensity 6 on the Rossi-Forel scale (ringing of bells, stopping of clocks, visible disturbance of trees and shrubs, etc.), which occurred on March 25 at 15h. 49·6m. U.T. and was felt at Milford Sound and Queenstown. Six subsequent shocks were felt in the same area though they were of lesser intensity. Other areas affected by earthquake activity were Opotiki (March 2), Motu (March 3 and 5), Pipiriki and Whangamomona (March 5, 6, 10, 12, 16 and 18), Napier and Hastings (March 20), and Te Whaiti and Taupo (March 22). Focal depths of these local earthquakes have been estimated to range from normal (about 16 km.) to 100 km. The bulletin is stated to be provisional, but it contains much useful data.

Colour of Machines and Workshop Efficiency

UNDER the title "Color for Efficiency", Matt Denning and Arthur A. Brainerd have described experiments made in an American machine shop by re-painting the machines in pale colours (*Product Engineering*, Jan., 1942). Machines are usually painted black or battleship grey, and their surfaces thus have a low reflexion factor. There is often too little brightness of colour contrast between the work and parts of machines forming its background. If these parts are finished with light-coloured paint, contrast is improved, and the work made easier to see. Moreover, the illumination of the work itself may be improved by light reflected from machine surfaces. The whole machine may be painted a uniform colour, or a different, but also pale, colour can be used for parts not in close proximity to the work. The general brightness of a machine shop is enhanced by this treatment. Where high machines, such as heavy presses, are used, a high reflectivity of their superstructure means that more light is reflected to adjacent machines, and troublesome shadows may be avoided. The colours tested were ranked on the results of a work-time study and on opinions of machine operators and measurements of reflexion factors. Light buff proved best, then aluminium and light grey. Yellow was found to be tiring. In Great Britain, the advantages of painting machines a light colour were recognized by the Departmental Committee on Factory Lighting, which recommended this practice in its fifth report, published in 1940; recent trials here have proved very satisfactory.

Hormone Sprays for Fruit

THE recent rapid developments in the investigation of growth-promoting substances have been closely followed by widespread attempts to apply the so-called plant hormones in horticultural practice. The use of synthetic growth substances to facilitate the rooting of cuttings became a craze almost overnight, and there is no doubt that remarkable results were achieved in many cases. There are still, however, species which resist all attempts to make them produce roots readily enough to make this method of propagation practicable on a commercial scale.

Other uses for growth substances have now become the centre of interest, and these form the subject of a review in the *American Fruit Grower* of June 1941. Perhaps the most successful application has been the use of naphthalene acetic acid and naphthalene acetamide to control the pre-harvest drop of apples. Spraying with dilute solutions of these substances, by delaying the formation of the abscission layer, enables fruits to be kept on the tree until a desirable degree of colour and maturity is reached. Fruit dropping from pears, plums, apricots, oranges and cherries has also been reduced, and, in the case of the latter, the sprayed fruits showed a lower acid and higher sugar content than the controls. Satisfactory results with some English varieties of apple have been obtained by similar methods at the East Malling and Long Ashton Research Stations. The method appears to be of particular value in combating the effects of strong winds. Also of interest is the checking of bud development by hormone sprays. By this means the risk of frost injury to fruit blossoms in spring may be reduced. Indole butyric acid, applied unilaterally to growing shoots of young apple trees, causes more rapid growth on the treated side. By this means the development of narrow-angled and therefore structurally weak crotches can be avoided.

Porcelain Insulators

WRITING in the *Electrical Review* of June 12, 1942, on the design of electrical insulators in relation to manufacturing processes, Dr. E. Rosenthal points out that methods of shaping ceramic materials are based on the plastic quality of the china clay and ball clay in the case of porcelain, and of clay, talcum or bentonite in the case of certain ceramics. The plasticity of ceramic materials is caused by the adsorption of water at the surface of the kaolinite crystals forming the china and ball clays, this water surrounding the clay molecule. The forces which attract the water to the molecules and crystals are electrical in origin and impart to the clay molecules their colloidal and plastic nature. The hygroscopic water and the "water of formation" form the colloidal gels which give to the clay particles their plastic

characteristics. All ceramic plastic materials also contain chemically combined water of crystallization. Although ceramic articles can easily be shaped as a result of the plasticity of their raw materials, the finished materials owe their physical and mechanical properties to the crystals and to the glass matrix formed during firing at high temperatures.

In contradistinction to ceramic plastic raw materials, the plasticity of organic plastics is not caused by water but by the long chains of carbon atoms or arrangements of carbon atoms with other elements of which their molecules consist. These chains are arranged in various forms, such as long bundles or micelles and in tangled masses composed of threads. During manufacture plastic organic materials are transformed by heat (or by heat and pressure) into a non-plastic state, nothing being evaporated. Only the structure of the big molecules is altered and as only very small shrinkage occurs greater accuracy in certain shapes can be obtained from organic-plastic than from ceramic materials. Incidentally, the molecules of ceramic plastics are built up of silicon compounds, whereas those of the organic plastics are built up of carbon compounds—an instance of the many similarities of these two elements. With organic plastics, transformation from the plastic to the non-plastic form which gives the materials their mechanical and electrical characteristics takes place at about 180° C. In the case of ceramics the formation of the crystals and the glass matrix, which imparts these characteristics, takes place between 1,300° and 1,400° C.

The difference between the manufacture of ceramic and other materials, such as metal parts and organic plastic materials, is therefore that the article is not shaped from ready-made material but has first to be prepared from various plastic and non-plastic substances. After the water is removed in a filter press the body is homogenized, and out of this body the article is shaped into the desired form which is then dried and glazed and subjected to very high temperatures for final formation. The methods of manufacturing porcelain and low-loss ceramic articles containing talcum are very similar. The article proceeds to a description of the various processes employed in the commercial production of porcelain insulators.

Stellar Structure

A PAPER on stellar structure appears in the *Observatory* of May, in which Dr. T. G. Cowling gives a brief summary of the work of various physicists on the theory of stellar structure during the past ten years. A large portion of the paper is devoted to recent developments in the physical theory of the generation of stellar energy. The work of Gamow, Weiszäcker and Bethe has shown that the most probable mode of generation of energy is by the transmutation of hydrogen into helium, atoms of carbon and nitrogen acting as catalysts in the reaction. Assuming that the temperature at the centre of a star is about 20,000,000° K., increasing temperature implies increasing rate of generation of energy—approximately as the seventeenth power of the temperature—and the popular idea was that instability of the star would ensue. This view is erroneous because the generation of energy does not affect the internal temperature for a period of the order of a million years, and in this time the star can adjust itself so as to dispose of the extra energy.

It has been argued that reaction between energy generation and temperature would produce radial oscillations, such as are observed in the Cepheids, but how can their absence in other stars be explained? A possible explanation may be found in the time-lag between increase in temperature and the resulting increase in generation. Another explanation given by Cowling is that a very large dissipation of the energy of an oscillation takes place in the outer layers of a star, but this dissipation is so large that it is difficult to understand why Cepheids continue to oscillate. Eddington believes that the dissipation in their outer layers is very low because of the changes in hydrogen ionization during the oscillation. On the whole, therefore, there are no objections on astrophysical grounds to the view that the energy of a star is nearly all generated in the hottest central part. Other matters considered include the Kelvin-Helmholtz hypothesis that stars radiate because gravitational energy is liberated as they contract, and observational evidence regarding the internal state of eclipsing binaries.

The University of London

THE title of professor emeritus of anatomy in the University has been conferred on Prof. J. E. S. Frazer, who resigned from the University professorship of anatomy at St. Mary's Hospital Medical School in March 1940. The title of reader in geography in the University has been conferred on Dr. S. W. Wooldridge, in respect of the post held by him at King's College.

The degree of D.Sc. has been conferred on Prof. R. V. Christie, University professor at St. Bartholomew's Hospital Medical College; Mr. Frank Dickens, of the Imperial College of Science and Technology; Mr. Charles Potter, of the Imperial College of Science and Technology; Mr. E. E. L. Dixon, an external student; and Mr. C. E. Lucas, an external student.

The University of the Philippines

FEARS were expressed, in the early days of the invasion by the Japanese of the Philippines when the open city of Manila was bombed, that the University and other colleges of the city, some of them of great antiquity, might have been damaged or destroyed. It is therefore welcome news to learn that no damage of any kind has been suffered by the buildings of the University of the Philippines or, apparently, by other educational institutions. The bombing was concentrated on a small area in another part of the city.

Announcements

Archbishop Lord Lang of Lambeth and Sir Charles Sherrington have been elected trustees of the British Museum.

Sir Henry Dale, president of the Royal Society, has been appointed chairman of the Science Committee of the British Council, in succession to the late Sir William Bragg.

Dr. F. W. Hardman and Mr. W. P. D. Stebbing, in two articles in *Archæologia Cantiana* (**53** and **54**), have outlined the history of Stonar and the Wantsum channel. As the prosperity of the place depended entirely on the state of the channel, this is discussed at some length in the first article. While the matter is primarily of interest to the local antiquary, there are aspects which make it of wider importance.

ERRATUM. NATURE, May 23, p. 584, col. 2, line 3 of second complete paragraph: before words "striking force" insert "the effect of".

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Metabolic Water and Desiccation

THE utilization by the body of ingested food substances and of tissue reserves yields among other things quantities of metabolic water. As the complete combustion of 100 gm. of fat produces about 110 gm. of metabolic water, whereas 100 gm. of carbohydrate yields only 55 gm. of water, fat reserves and fatty foods are believed to be particularly valuable as a protection against desiccation. This contention would appear to be supported by the fact that many animals which exist in deserts have large reserves of fat.

I believe that the idea that fat is primarily a protection against desiccation is based on fallacies. Terrestrial animals, which have evolved eventually from aquatic forms of life, are always apt to suffer from desiccation, and many well-known mechanisms for water conservation exist. Respiration always presents a difficulty, and a serious loss of water often takes place from the surface of respiratory organs. The more a terrestrial animal takes in oxygen, during respiration, for its metabolism, the more water there will be lost in the (practically saturated) expired air; this is equally true of insects and mammals. In man, the water lost from the lungs is generally greater than the total production of metabolic water. When desiccation is the limiting factor (and animals usually die from lack of water long before their food reserves are exhausted) the significant figure is not the amount of metabolic water produced for unit consumption of any reserve, but the amount of metabolic water produced for unit oxygen uptake. When burning fat, to produce 100 gm. of metabolic water, 255 gm. of oxygen must be absorbed; to produce 100 gm. of metabolic water from carbohydrate only 213 gm. of oxygen need be used. I believe therefore that an animal living on fat may actually be worse off as regards the production of metabolic water than one living on carbohydrate.

The same conclusion may be arrived at in a different way. Fat has a much higher calorific value than carbohydrate, but while for every 1,000 calories produced by burning fat only 120 gm. of water are produced as a by-product, when carbohydrate is burnt 130 gm. of water are manufactured for the same calorific yield. Thus if an animal performs the same sort of activities on a predominantly fatty diet, it will actually produce less water than on a predominantly carbohydrate diet.

There is one way in which the conclusion given above may need to be modified. Possibly when an animal is metabolizing fat it may obtain the extra oxygen, not entirely by increased ventilation, but partly by an increased utilization of the oxygen in the blood, with a consequent reduction of the venous blood to a level lower than that found when carbohydrate is burned. We do not know that this actually happens, for there appears to be little information concerning the composition of venous blood when different food substances are used. If it does, however, carbon dioxide production in relation to the control of ventilation must be considered. 244 gm. of carbon dioxide are produced for each 100 gm. of metabolic water manufactured from fat, and 293 gm. of carbon dioxide for 100 gm. of water from carbohydrate, so ventilation (largely controlled by carbon dioxide) and therefore evaporation from the lungs may actually sometimes be greater when carbohydrate is being used. This does not invalidate the conclusions given above concerning the amounts of water produced for each calorie when different foodstuffs are burned, and without further work it is very doubtful whether such differences in the oxygen content of the venous blood of normal resting individuals are to be found. In general then, it is clear that fat cannot in a given time give appreciably more metabolic water than carbohydrate, and most of the evidence suggests that it gives considerably less.

The only advantage of fat over carbohydrate under conditions where desiccation is likely (in deserts or lifeboats at sea) is that a smaller weight will have a higher calorific value and will give more water of metabolism than the same weight of carbohydrate. However, carbohydrate foods are generally less bulky, more easily stored and non-perishable; furthermore, very fatty diets are likely to give nausea and acidosis.

Desert animals store fat in their bodies because fat is the only food substance which animals can store in any quantities. But they store the fat as a food and not as a water reserve, for in deserts starvation is as great a danger as desiccation. In fact, many animals avoid desiccation by living in burrows where an almost saturated micro-climate is found even although the outside air may be extremely dry.

KENNETH MELLANBY.

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June 13.

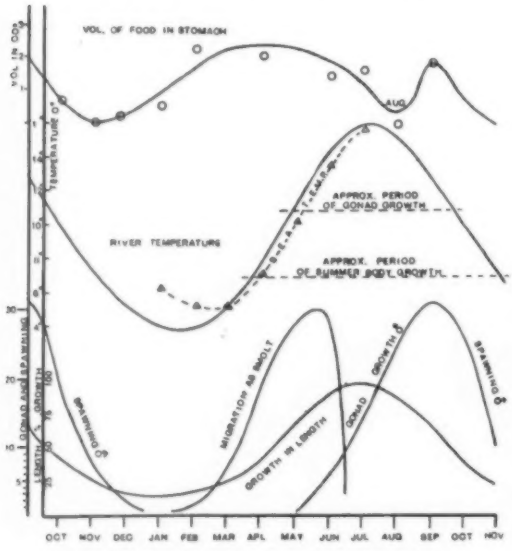
Biology of Young Salmon (*S. salar*, Linn.)

IN the period immediately preceding the outbreak of the present War a close study had been made of the biology of young salmon, that is, salmon parr (*S. salar*), in various localities of Great Britain and Ireland [1-9]. It seems advisable in the existing conditions of war to review these investigations and particularly those carried out on the Welsh Dee. The accompanying figure correlates in one picture much of the work done on this river; the results obtained in other localities are not very different.

It would appear from all these investigations that rapid growth is related to feeding only at or above a particular temperature-level and may, moreover, be checked in the male by the later stages of gonad growth and spawning. Gonad development in the male is correlated with an accumulation of fat reserves following rich feeding and apparently also with a particular temperature-level. Spawning in the male is correlated with a rapid fall in temperature and a falling off in the amount of food taken (and available). Fat reserves are used up in the young male in the production of gonad but not in the female. An increase in the amount of food taken is not followed *at once* by an accumulation of mesenterial fat reserves, nor apparently an improvement in 'condition', ($K = W/L^3$), but the laying down of mesenterial fat is soon followed by testis development in the males. Smolt migration begins during the early phase of acceleration of growth in body-length, and appears to receive an early impulse about the time of the rise in river temperature from the minimum. A close relation exists between river and sea temperature at the time of migration. There is no information available yet on metabolic state at the time of

migration, but mean size is known to vary with the type of environment.

How far the correlations brought out in these investigations apply to all habitats of young salmon remains to be found. The results from the Rivers Dee (Wales), Eden and the Eire rivers do not appear to be strikingly different, nor are the environments very dissimilar from a broad view, and it is recognized that strongly contrasting environments are needed to evaluate the correlations noted above. Investigations similar to and indeed more extensive than those carried out on the Dee are required from markedly different environments. Ideally, the environments chosen should cover the geographical range of the species, so that the extreme habitats in Great Britain, for example, northern Scotland and southern England, may not be sufficiently critical. The inclusion of habitats in Scandinavia and France in the investigations would greatly enhance the value of a survey on the biology of young salmon.



SOME FACTORS IN THE BIOLOGY OF SALMON PARR.

Vol. of food (Carpenter[4]) is given in c.c.'s as a criterion of food value; nutritive value estimations would be better; *River temperature* is given for the Dee (Wales) as monthly means over a period of ten years (Jones and Orton[3]); *Sea temperature* for the Liverpool Bar L.V. (1928–32) given by the broken line approximates to (and is normally lower than) that of the Dee Estuary during the migration period (Orton[6]); *Gonad growth* in the male is derived from the numerical stage of gonad × percentage of those stages in the total sample examined (Jones and Orton[3]); *Spawning* is represented simply as the decline of the graph for gonad growth in the male population; *Growth in length* is an arbitrary curve from Jones's unpublished work; *Migration as smolt*, including appearance of smolt coat, is an arbitrary curve mainly from summarized observations of J. G. D. Watts and G. M. King, during a period of 13 years, in Annual Reports, Dee Fishery Board, 1929–41; *Condition and mesenterial food reserve* follows closely the graph for gonad growth in the male (Orton and Jones unpublished, Allen[2b], Frost and Went[5]).

The problems in the biology of young salmon therefore demand team work not only in each of several localities but also on a broad geographical basis Simultaneous team work in localities in Great Britain was being attempted at the outbreak of war; it may well be desirable in the solution of the problems to extend the team work to other countries for the purpose of comparing an adequate range of environments when investigations of this kind can be resumed.

J. H. ORTON.

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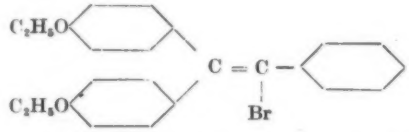
June 4.

[1] Orton, Jones and King, *Proc. Roy. Soc.*, B, **838**, 103 (1938).
[2] Allen, *J. Anim. Ecol.*, **9**, 1, 1 (1940) (*a*); **10**, 1, 47 (1941) (*b*); **10**, 2, 273 (1941) (*c*).
[3] Jones and Orton, *Proc. Roy. Soc.*, B, **813**, 485 (1940).
[4] Jones, *Proc. Roy. Soc.*, B, **499** (1940).
[5] Frost and Went, *Proc. Roy. Irish. Acad.*, **48**, B, 4, 53 (1940).
[6] Carpenter, *Proc. Zool. Soc.*, A, **110**, 81 (1940).
[7] Went, *Sci. Proc. Roy. Dub. Soc.*, **22**, 35, 327 (1941).
[8] Orton, James Johnston Mem. Vol., Liverpool, 118 (1934).
[9] Jones, *Proc. and Trans. Liv. Biol. Soc.*, **52**, 19 (1939).

A New Synthetic Œstrogen with Prolonged Action when Given Orally

THE discovery of the synthetic œstrogens put at our disposal substances which had the great advantage of being highly active when given by mouth. Of these, stilbœstrol has been extensively used and has proved of great value. This substance, however, has only a short period of action so that clinically it has to be given at frequent intervals in order to produce a sustained effect.

We have examined a large number of substances, including derivatives of triphenyl ethylene, in an attempt to obtain an œstrogen which would produce a prolonged effect not only when given by injection, but also when administered orally, and have obtained one substance, αα-di-(*p*-ethoxyphenyl) β-phenyl bromoethylene (D.B.E.), which appears to be promising from that point of view. The formula of D.B.E. is as follows:



The activity of the substances was determined on groups of ovariectomized mice by quantitative methods previously described [1,2].

TABLE 1. COMPARING THE DURATION OF ACTION OF VARIOUS ŒSTROGENS ADMINISTERED SUBCUTANEOUSLY IN OVARIECTOMIZED MICE

Substance	Dose (μ gm.)	Duration until action halved (days)
Stilbœstrol	0·1	3
	50	9
	500	16
Œstradiol dipropionate	100	21
	500	50
Triphenyl chloroethylene	50	0
	100	12
D.B.E.	20	4
	100	93

The œstrogenic actions of D.B.E. and of a number of other œstrogens are compared in Table 1. These effects were obtained when these substances, in

solution in oil, were injected subcutaneously into groups of mice in four doses over forty-eight hours.

TABLE 2. COMPARING THE DURATION OF ACTION OF VARIOUS ŒSTROGENS ADMINISTERED ORALLY IN OVARIECTOMIZED MICE

Substance	Dose (μ gm.)	Duration until action halved (days)
Œstradiol	5	3
	50	7
	500	17
Stilbœstrol	0·1	3
	500	20
Triphenyl chloroethylene	100	4
	500	13
D.B.E.	10	7
	50	21
	500	38

It will be seen, that though D.B.E. has a relatively high threshold, a small increase in the dose produces a very marked prolongation in the duration of its action. In this respect it is similar to the di-esters of œstradiol.

For the oral administration, the substances, in solution in oil, were introduced into the stomach by means of a stomach tube; a single dose was given to each mouse. Each test was carried out on a group of ovariectomized mice. The activity of D.B.E. and of a number of other œstrogens so administered is given in Table 2.

It will be seen that D.B.E. has an oral threshold similar to that of œstradiol and much higher than that of stilbœstrol. Unlike œstradiol and stilbœstrol, however, a relatively small increase in the oral dose of D.B.E. produces an appreciable increase in the duration of its action. It would therefore seem that, after absorption from the alimentary canal, D.B.E. is stored somewhere in the body and slowly released to produce a prolonged effect.

It is intended to investigate the question of the storage of D.B.E. and its possible clinical value.

The expenses of the biological part of this investigation have been defrayed by a grant from the Medical Research Council.

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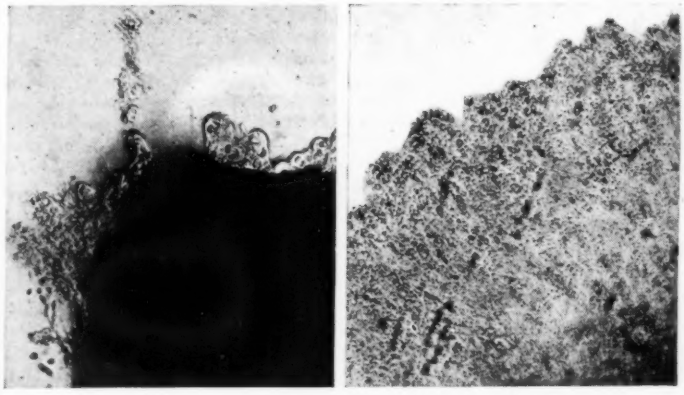
[1] Robson, J. M., *Quart. J. Exp. Physiol.*, **28**, 195 (1938).
[2] Robson, J. M., Schönberg, A., and Fahim, H. A., NATURE, **142**, 292 (1938).

Effect of Extracts of Heterologous Adult Tissue on Cell Growth *in vitro* and their Use in Wound Healing

IN previous papers[1] we have reported that the ability to promote the growth of cell cultures *in vitro* is common to extracts of various tissues and organs of adult animals, and that this property is independent of the rate of proliferation of the tissue from which the extract is made. Extracts of some mitotically stable organs of adult fowl (brain, cardiac muscle, smooth muscles) activate the growth-rate of chicken fibroblasts to a remarkably high degree.

Further investigations were carried out to determine whether the growth-promoting ability of adult tissue extract is restricted to homologous cells only or manifested also on cells from foreign species. Carrel[2], who was aware of the growth-promoting power of homologous adult tissue extracts, stated that whereas embryo extracts, homologous and heterologous, are equally effective, extracts of heterologous adult tissue stimulate cell-growth only slightly if at all.

The growth-promoting activity of tissue extracts was tested in the present experiments on stock cultures of chick heart fibroblast according to the technique previously described[1]. The extracts tested were prepared from heart muscle of sheep, cow, rabbit and dog. The growth of the cultures in media containing these extracts was compared with the growth of control cultures in a medium containing chicken heart muscle extract. Consistently uniform results were obtained. Heart muscle extracts of all species used have the power of strongly stimulating the growth of chicken cells *in vitro*. The pattern of the cultures and the appearance of the individual fibroblasts vary somewhat with different extracts, but the growth-stimulating effect of heterologous tissue extracts was in every case of the same order of magnitude as that of homologous extract.



a *b*

FIVE-DAY-OLD CULTURES OF HUMAN SKIN EPITHELIUM. LIVING (× 40)
(*a*) in protective medium; (*b*) activated with extract of heart of adult fowl.

These experiments were further extended to include human tissue. The question was examined whether and to what extent the growth of human epithelium *in vitro* is stimulated by extracts of heart muscle from adult fowl. Skin fragments fresh from operation (fragments of skin were obtained through the kindness of Major M. C. Oldfield) were explanted in Carrel flasks and maintained both in protective medium and in medium containing 15 per cent chick heart extract respectively. Skin fragments maintained in the protective medium (fowl plasma and Tyrode solution) showed only a few epithelium buds and shoots after five days of incubation. Fragments grown in medium containing heart extract, on the other hand, were after five days surrounded by a broad zone of densely packed epithelial cells. The

growth area of newly formed epithelium in human skin cultures activated by adult tissue extract bore a ratio of 16 : 1 to that of non-activated cultures (average of fourteen experiments). The growth-accelerating effect of extract of adult fowl heart on human epithelium is thus very pronounced.

In view of the experiments reported above, the following consideration seems justified. Attempts have been made by various workers[3] to assist the process of wound healing by means of cell growth-promoting tissue extracts. The results of these experiments have been consistently favourable. The process of wound healing is accelerated, and non-healing wounds can be induced to heal under the influence of extracts which activate cell growth. Despite the favourable results of the clinical experiments, the use of growth-promoting tissue extracts in wound treatment did not find general application. In all clinical trials carried out, the source of growth-promoting substances was embryo extract, which is not particularly easy to obtain and quickly loses its growth-promoting power. This circumstance rendered this method completely impracticable. The fact that extracts of heterologous adult tissue are capable of strongly stimulating the proliferation of human cells suggests a new and simple solution of the problem. Extracts of adult tissues combine a twofold advantage : they are highly potent and they are easily available.

To sum up. Extracts of heterologous adult tissues stimulate cell growth *in vitro* to a high degree. Their efficacy in wound healing is to be expected, but has to be proved by therapeutic experiments. Treatment of wounds by adult tissue extracts is being carried out in the Surgical Department of the Hadassah-University Hospital, Jerusalem. A paper reporting the results of clinical trials is to be published shortly.

This work has been aided by a grant from the Dazian Foundation for Medical Research.

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[1] NATURE, **143**, 764 (1939). *Growth*, **3**, 61 (1939); **4**, 207 (1940). See also Trowell, O. A., and Willmer, E. N., *J. Exp. Biol.*, **16**, 60 (1939).

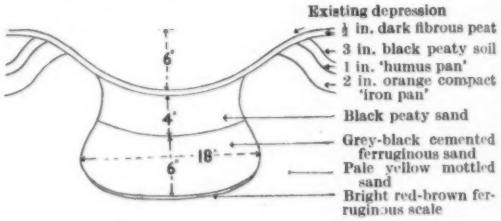
[2] *J. Exp. Med.*, **17**, 14 (1913); **38**, 499 (1923).

[3] Bergami, G., *Rend. R. Accad. d. Lincei*, **2**, 140 (1925). Carnot, P., and Terris, E., *C.R. Soc. Biol.*, **95**, 655 (1926). Roulet, F., *C.R. Soc. Biol.*, **95**, 390 (1926). Wallich, R., *C. R. Soc. Biol.*, **95**, 1480 (1926). Kiaer, S., *Ar. klin. Chir.*, **149**, 146 (1927). Schloss, W., *Ar. klin. Chir.*, **151**, 701 (1928). Nakamura, T., *C.R. Soc. Biol.*, **104**, 191 (1930). Sandelin, H., and Björkesten, G., *Finska läk. Handl.*, **74**, 826 (1932). Nielsen, E., *Ugeskr. Laeg.*, **37**, 1071 (1939). Waugh, W. G., *Brit. Med. J.*, **1**, 249 (1940). Riley, J. F., *Brit. Med. J.*, **2**, 516 (1940).

Human Activities and Soil Characteristics

THERE are probably few lowland areas in Great Britain where the development and characteristics of soils have not been materially altered by the impact of human activities ; it is, nevertheless, often assumed that portions of the New Forest have been little influenced by man's interference. Investigation would suggest, however, that such is far from being the case, and that comparatively unobtrusive factors have exerted effects which often obscure and complicate the fundamental soil-forming processes.

Recently, as part of an effort to improve the quality of the forest grazings, a fairly level 'moor' at Pilley near Lymington was ploughed ; the existing flora consisted mainly of *Erica tetralix* and *Calluna vulgaris* (dom.), with *Molinia cærulea*, *Agrostis setacea*, *Ulex minor*, Carex and Lichen, in an open community. Over a considerable area, the occurrence was observed of parallel orange-coloured bands, extending in varying directions on the bottoms of the furrows, at about 4 in. below the surface. In a few instances these bands could be identified with the impressions of old cart tracks ; a typical soil profile is shown in the diagram.



According to local informants, marl was at one time carried across the moor from pits to farms lying beyond its margins. The marl carting apparently commenced about 1840, using, in the early days, oxen teams with broad-wheeled carts ; the practice was finally discontinued around 1890.

It would appear possible that the pressure of the wheels broke the continuity of the iron pan, which was forced downwards, below the rut, while the adjacent pan outside the rut was forced up and exposed at the surface. The depression was afterwards filled by washing in from the sides, and in many cases has practically disappeared. The exposed ferruginous material underwent a change in colour from orange to dull brown, and the whole became covered by a thin horizon of humous material, of recent origin.

Taken as a whole, the soil characteristics of this moor are now rather variable. Apart from the profile already described, at certain sites a typical podsolic bleached A^2 horizon is discernible ; at others, a few yards distant, the iron pan is overlain by a black peaty sand. The 2-in.-thick iron pan appears nowhere to lie more than 6–8 in. below the surface, while the superficial A^0 horizon of peat is only about ½ in. and the bleached sandy A^2 about 2 in. in depth.

It is difficult to believe that the present poorly developed eluvial horizons correspond with the strongly developed illuvial horizons now observable, and it is suggested that the original A^0 and A' horizons may have been removed by the intermittent operations of peat cutting and heath burning, known to have been practised in the past.

In the opinion of the writer, the foregoing serves to illustrate the difficulty in interpreting the various factors which have affected soil-forming processes, even in an area which, at first sight, might be thought to have developed under the influence of purely natural agencies.

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Reading.
May 27.

A New Synthesis of X-Ray Data for Crystal Analysis

IT is unfortunate that Dr. Yü is not more easily accessible to direct correspondence about his new synthesis of X-ray data for the determination of crystal structures[1]. If the method is what he claims it to be, it is certainly an important advance; the details he gives, however, are not self-explanatory, and physical reasoning would suggest that the advantages he claims cannot possibly be obtained from the X-ray data given by any actual crystal.

The number of X-ray spectra obtainable from a crystal is limited by the natural decrease in intensity with angle; thus there is a limit to the resolving power of the 'X-ray microscope'. This limit is not, as for optical instruments, an artificial one that depends on the conditions of experiment; it is an expression of the fact that atoms have a natural diffuseness due to their finite size and thermal motion. Crystals composed of dimensionless atoms would give spectra that did not, on the average, decrease with angle.

Now Yü has claimed, in effect, that he has produced a synthesis with no limit to the resolving power. To do this he produces a set of quantities E_h which are related to the observed intensities but which are so corrected that they do not, on the average, decrease with angle. This, in agreement with my statement above, is the condition necessary for infinite resolving power. These E_h's are then multiplied by the quantities $a_{\mu h}$; Yü does not define these but states that they decrease with h so that his series $\sum_{h=0}^{\infty} a_{\mu h} E_h$ can be terminated at a reasonable value of h. It seems to me, however, that if the high-order intensities are not included in the series, the resolving power cannot be infinite; that the convergence is in the a's and not in the E's is immaterial.

The method, of course, cannot be completely understood until all the details are available. Nevertheless, I suspect that there is no essential difference between Yü's synthesis and Patterson's, except that Yü considers his as a function that has appreciable values only at discrete points, whereas Patterson's is continuous. It is doubtful whether this concept has any advantages over the older one, but it will be interesting to see whether the publication of Yü's $a_{\mu h}$'s will lead to any simplification of the processes involved in the summations.

H. LIPSON.

Cavendish Laboratory,
Cambridge. June 17.

[1] YÜ, NATURE, **149**, 638 (1942).

A Relativity Query

As is well known, Einstein's theory of gravitation predicts three small effects not previously known. Two of these are the deflexion of light rays passing near the sun and the advance of Mercury's perihelion. I have found that these are given very simply by Fermat's principle and the principle of least action respectively.

The matter can be put shortly, as follows:

$$\delta \int \sqrt{1 + \left(r \frac{d\theta}{dr}\right)^2}\, dr = 0, \qquad (1)$$

an application of Fermat's principle, gives the straight line; r and θ are two-dimensional polar co-ordinates.

$$\delta \int \sqrt{\frac{2km}{r} - C} \sqrt{1 + \left(r \frac{d\theta}{dr}\right)^2}\, dr = 0, \qquad (2)$$

an application of least action, gives the ellipse. Now repeat the two equations but suppose that the medium is very slightly ælotropic, writing

$$\sqrt{n_r^2 + \left(n_\theta\, r \frac{d\theta}{dr}\right)^2}\, dr$$

for the element of optical length where

$$n_r = n_\theta^2 = \left(1 - \frac{2km}{rc^2}\right)^{-1}$$

and c is the velocity of light. The application of Fermat's principle then becomes

$$\delta \int \sqrt{n_r^2 + \left(n_\theta\, r \frac{d\theta}{dr}\right)^2}\, dr = 0; \qquad (3)$$

and the application of least action

$$\delta \int \sqrt{\frac{2km}{r} - C} \sqrt{n_r^2 + \left(n_\theta\, r \frac{d\theta}{dr}\right)^2}\, dr = 0 \qquad (4)$$

The two equations give respectively *exactly* the same paths as Einstein obtains for the passage of the light ray and the planet in the sun's gravitational field. The results come out very easily. It is the slight ælotropy of the medium that constitutes the difference between Newton and Einstein. The first three equations can be obtained from the final one by omitting the appropriate terms.

Now these seem to be important results, and there is a strong probability that they have appeared in print before, but I have not been able myself to find a reference to this having happened, neither have authorities whom I have consulted. Can any reader of NATURE give me information?

R. A. HOUSTOUN.

University, Glasgow.
June 15.

Geologists in War-Time

MIGHT I suggest that the lack of interest shown in the work of geologists in war-time, complained of by Dr. F. Coles Phillips in NATURE of April 4 last, is a continuation of a similar lack of interest in peace-time? This subject was dealt with ably by Prof. P. G. H. Boswell in his presidential address to the Geological Society of London last year, and it is now being realized that, admirable and fundamental as pure science may be, any branch of science which is not linked to everyday life is bound to suffer the fate that is being suffered to-day by pure geology. Mining and oil geology have already robbed the science of many potential adherents, but what has struck me most since my interest in geology was aroused over twenty years ago has been its complete neglect of its possible application to allied sciences. Thus to take only those cases of which I have personal knowledge, building stones, road and building aggregates, and greater than these, soil mechanics, are all examples of subjects which could have been developed by geologists, but which have been left by them to chemists, physicists and engineers with markedly beneficial results to those branches of science and a corresponding loss to geology.

It should be realized by geologists that the natural corollary to the statement made above is that a greater interest in allied sciences by them is needed; the impetus must come from them; it will certainly not come to them from other quarters.

BERNARD H. KNIGHT.

Civil Engineering Department,
University of the Witwatersrand,
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May 30.

RESEARCH ITEMS

Development of the Liver in the Salmon

HELEN I. BATTLE has investigated the hepatogenesis of the Atlantic salmon (*Salmo salar* L.) (*Canadian J. Res.*, **20**, Sec. D, No. 4; April, 1942). Little is known about the early embryology of the liver in teleostean fishes, expecially of the Atlantic salmon, and this detailed study is a valuable contribution to the subject. Many problems of interest arise, not merely in the embryonic phases but also following the larval period, when the liver undergoes an enlargement, and a differential growth accompanies the metamorphosis of other structures already observed as constituting the transition from parr to smolt. The present work deals with the gross morphological changes in the liver during development from the initial appearance of the 'anlage' in the 4-mm. embryo to the adult. A later paper will deal with the simultaneous histogenesis.

American Freshwater Amphipoda

CLARENCE R. SHOEMAKER has given useful keys to the families and genera of American freshwater Amphipoda, describes several new species, and redescribes others imperfectly known ("Notes on Some American Freshwater Amphipod Crustaceans and Descriptions of a New Genus and Two New Species", *Smithsonian Misc. Coll.*, **101**, No. 9. Smithsonian Institution of Washington, Publication 3675; 1942). Among the new species are some interesting cave-dwellers. One is from a cave in Cuba described first by Ada L. Weckel and now placed in the new genus Weckelia, another is a large Crangonyx from caves in Pennsylvania, discovered by Kenneth Dearolf, representing a new species, *Crangonyx dearolfi*. Four families of freshwater Amphipoda are so far known from America: Corophiidæ, Talitridæ, Haustoriipæ and Gammaridæ. Only one genus each is represented in the Corophiidæ (Corophium), Talitridæ (Hyalella), and Haustoriidæ (Pontoporeia), but there are two sections in the Gammaridæ, the Gammarus and Crangonyx sections, with several genera.

Translocations in *Appotettix eurycephalus*

R. K. Nabours, F. M. Stebbins and W. R. B. Robertson (*J. Exp. Zool.*, **38**, 239; 1941) report further results from X-raying males of *Apotettix eurycephalus*. Among the translocations observed in the progeny were two translocations: between chromosomes 1 and 4 and between chromosome 1 and the *X*-chromosome. Genetical analysis of the genes *OTG* and *W* and cytological evidence enable the authors to place the genes on chromosome 1 in respect to the centromere. In the case of the reciprocal translocation involving the *X*-chromosome and chromosome 1, it was found that the autosomal gene *W* had become transferred to the *X*-chromosome and showed sex linkage. Considerable data of the viability of animals with different chromosome abnormalities were obtained and it was shown that quite frequently a zygote with an abnormal chromosome constitution lived until the third or fourth instar.

Localized Chiasmata in *Fritillaria Meleagris*

MEIOSIS in normal *Fritillaria Meleagris* is characterized by the bivalents being held together at metaphase by chiasmata strongly localized near the centromere. By treating the early stage of meiosis with colchicine and with heat, H. N. Barber (*J. Genetics*, **43**, 359; 1942) has been able to analyse the phenomenon more fully. He finds that heat treatment at the time of chromosome pairing reduces the chiasma frequency and tends to increase the proximal localization. On the other hand, treatment with colchicine reduces the chiasma frequency, and localization disappears. Indeed with colchicine pairing takes place at several places on the chromosome, which results in considerable interlocking. The interpretation given is that heat reduces the time limit of pairing and thus reduces the chiasma frequency without influencing the general method of pairing. Colchicine, on the other hand, by influencing the region of the centromere, reduces its advantage in pairing and slows the general rate of pairing. Normal localization in *F. Meleagris*, therefore, is taken as depending on an early limit of pairing and a centromere control of the contact points of the chromosome.

Respiratory Channels in the Tomato Fruit

K. A. GLENDENNING, biochemist at the National Research Laboratories, Ottawa, has followed up some observations upon the respiratory activity of the detached fruit of the tomato with a study of the behaviour of the fruit while still attached to the plant (*Canadian J. Res.*, **20** (4); April, 1942). There is clear evidence that the ripening colour change on the vine involved at first a rise in respiration, to the yellow orange stage, followed by a decline as the fruits ripened to full red. A similar respiratory drift had been noted in detached fruits, and there the remarkable fact had been observed that this rise and fall may be abolished completely and the associated colour changes seriously modified, by blocking the stem scar area with melted wax. It is known that the act of detachment does not interfere seriously with respiratory activity so it was interesting to see if any region could be blocked in the still attached fruits so as to modify the respiratory ripening changes similarly. It was found that fruits failed to show the normal colour changes when melted wax was applied to the area of the fruit ordinarily covered by the calyx and also to the parts of the pedicel immediately adjacent to the receptacle and to the receptacle itself in the angle between pedicel and fruit. Most of these fruits abscissed relatively early. The area of free gaseous interchange in the attached tomato fruit thus appears to be associated with this surface region of the fruit.

Carboniferous Lycopods

J. M. SCHOPF's recent work on American material makes valuable progress with the fossil Lycopods. One paper (Illinois Geol. Surv., Rep. of Investigations, **50**) deals with isolated megaspores, which are now coming to be used as one of the means for recognizing individual coal seams. Various types are discussed, including ones belonging to Lycopod seeds for which a genus is made. A second paper (*ibid.*, Circular **73**) consists of a critical discussion of the Lycopod seeds Lepidocarpon, which are numerous in America. A third (*ibid.*, Report of Investigations, **75**) deals with the rather obscure genus Mazocarpon Benson. A new species is described from abundant male and female cones which are so well preserved that the single large archegonium of the female prothallus is clearly seen. Various points are cleared up; for example, the ligule which is recognized; and it is interesting that the idea that this is the cone of Sigillaria is strongly supported, and also that the

megaspores are shown to be one of the commonest types in coal seams. The idea that this cone shows an approach to the seed production of Lepidocarpon must be given up. It is specialized on different lines, but at the same time it is not yet clear how the spores were shed. This remarkable material should be able to provide information on this and other points of the life-history of Sigillaria.

Constitution of Agar

In some experiments described by W. G. M. Jones and S. Peat (*J. Chem. Soc.*, 225; 1942) evidence is presented that agar is the sulphuric acid ester of a linear polygalactose, the unit chain being composed of nine *d*-galactose residues mutually combined by 1 : 3-glycosidic linkages, and terminating at the reducing end by a residue of *l*-galactose, united with the rest of the chain by a glycosidic linkage engaging C_4 and not C_3. The *l*-galactose member is esterified at C_6 with sulphuric acid. This structure is shown to account for some reactions studied. The interesting suggestion is made that in the biological synthesis of agar a sulphate fulfils a similar function to the phosphate in the enzymatic synthesis of starch from glucose 1-phosphate, and this is explained more fully. The phosphoric acid is not retained in the starch, but with the agar the sulphuric acid, functioning as *d*-galactose 1-sulphate, remains with an adjusted orientation as an integral part of the molecule.

Copper Compounds

The hydrated blue gel thrown down by addition of a base to a cupric salt solution passes into black cupric oxide at a rate depending on the conditions of formation. H. B. Weiser, W. O. Milligan and E. L. Cook (*J. Amer. Chem. Soc.*, **64**, 503; 1942), by phase rule and X-ray diffraction methods, have shown that $Cu(OH)_2$ is the only compound formed in the $CuO—H_2O$ system, although four definite lower hydrates have been reported by another worker. The brown to black oxide CuO is formed by spontaneous decomposition of the cupric hydroxide gel, this being (as has long been known) accelerated by contact with dilute alkali. If the ratio of equivalents of cupric sulphate to alkali in a mixture is less than or equal to 1, the blue precipitate is pure cupric hydroxide; if it is equal to or greater than 1·33, the precipitate is basic sulphate, $4CuO, SO_3, 3H_2O$, identical with the mineral brochantite; if the ratio is 1·25, it is a new compound, $5CuO, SO_3, xH_2O$; if between 1 and 1·25 a mixture of this and cupric hydroxide; if between 1·25 and 1·33 a mixture of the two basic sulphates formulated above. The identity of the new basic salt $5CuO, SO_3, xH_2O$ was established by several methods, including analysis of crystals.

Renin

It was known that the intravenous injection of saline extracts from fresh kidneys causes a prolonged rise in blood pressure, and this has been shown to be due to the presence in the extract of a protein renin, soluble in water and dilute salt solutions, insoluble in alcohol and deactivated by heat and capable of purification by fractional precipitation by ammonium sulphate. O. Schales (*J. Amer. Chem. Soc.*, 64, 561; 1942) has now described a method by means of which it can be obtained in good yields and with a high degree of purity. This is a long and rather complicated process, which is set out in detail. Renin appears to be a pseudoglobulin. No evidence of the presence of a removable prosthetic group has so far been found.

Structure of Complex Fluorides

Interest has recently been taken in the determination of the structures of complex ions containing fluorine and apparently having the unusual coordination number of 7. Cubic crystals of potassium and ammonium heptafluozirconates contain the ZrF_7''' ion with point-group symmetry of $C_{3v} - 3m$. The fluoxyniobate ion $NbOF_6'''$ has a similar configuration in cubic crystals of K_3NbOF_6. Monoclinic crystals of the isomorphous K_2NbF_7 and K_2TaF_7 contain the complexes NbF_7'' and TaF_7'' with the point-group symmetry $C_{2v} - mm$. J. L. Hoard and M. B. Williams (*J. Amer. Chem. Soc.*, **64**, 633; 1942) have now examined the structure of $(NH_4)_3SiF_7$ by X-ray analysis. The result shows that this does not contain an ion with 7-covalency similar to those just mentioned, but the crystals are ordered aggregates of NH_4^+, F' and octahedral SiF_6'' ions, and hence the salt (which was discovered by Marignac in 1859) can best be represented by the double-salt formula $(NH_4)_2SiF_6, NH_4F$. Some of the interatomic distances are 10 per cent larger than anticipated for the coordination number involved. This is correlated with the very soft character and limited stability of the crystals, and the unusually large effects of thermal vibrations on the observed intensities of the diffraction maxima.

Defects in Glassware

At a meeting of the Society of Glass Technology on June 16–17, A. J. Holland, Eric Preston and W. E. S. Turner presented a paper on "Cords, Surface Finish and the Quality of Glassware". Omitting from consideration those defects classed as stones, seeds or blisters, the two main defects which impair the quality of glassware are those which occur in the body of the glass due to the presence of 'cords', and those present on the surface and which are largely dependent on mould conditions. A comparison was made of direct-shadow, polariscopic and photo-optical methods of determining cordiness. For routine comparisons and control, the direct-shadow method is extremely sensitive and excellent degrees of cord estimation can be accomplished in this way if preliminary standards are first set up over a sufficiently wide range—a 'figure of merit' was obtained depending on the range of cordiness covered by the reference samples. A thermostatically controlled centrifuge was also set up to separate from finely powdered glass samples glass of differing densities, and in this way an estimate of cord could be obtained either by giving the total density spread of a sample, or the mass-density distribution in the form of a grading curve. The defects which occur on the surface of the ware arising from contact with moulds or tools used in shaping the glass object have been but little investigated. A general comparison of surface conditions can be made, again, by a shadow method, but an optical method is to be preferred. It is even more difficult to give a numerical value for surface condition than for cord, but again a satisfactory 'figure of merit' is obtainable from standards set up and photographed at magnifications between 50 and 100 under conditions of oblique illumination. A scheme is in hand, however, for the utilization of an optical method, which, as in the case of cords, would give a value independent of the observer's judgment. In view of the minuteness of the surface unevennesses, however, it is not anticipated that such a method would be very sensitive.

RECENT ARCHÆOLOGICAL RESEARCH IN TRANSCAUCASIA

PROF. B. A. KUFTIN has been carrying on important excavations in Transcaucasia (1936–39): he made a preliminary report to the Leningrad Institute for the History of Material Culture (*Kratkie Soobshcheniya*, **8**, 1–35, figs. 1–18; 1940) and the definite statement of his results has now been produced by the Georgian Academy of Sciences.

In the latter part of the last century, Russian, and some European, museums were flooded with objects from Koban, Samthavro, Kumbulta, Faskau, Rutkha and other sites in the main chain of the Caucasus. They were very handsomely published by the Countess Uvarov and others (for example, *Mat. po Arkheologii Kavkaza*, **8**), being obviously of great interest, but being the result of predatory excavations carried out upon very steeply sloping sites had no stratification recorded: things from 1500 B.C. to A.D. 500 were all jumbled up together. Prof. Kuftin excavated a series of sites farther south yielding analogous objects and throwing light on these older finds; for example, things which had been regarded as perhaps decadent and belonging to the last centuries B.C. now turn out to be primitive and can be safely put at 1500 B.C. His sites range from epipalæolithic with the obsidian tools long known in Caucasia, to Hellenistic, Roman and Sassanian times. He has also introduced some order into the different styles of painted pottery, correlating them with those in Elam, Mesopotamia and the regions north of it. He points out that the brilliance of the Van kingdom has concentrated attention on that period within its area, and that we know very little of what went before it.

Without a large number of illustrations it is impossible to convey an intelligible idea of these results. It may be said, however, that Prof. Kuftin has correlated the Cyclopean forts of southern Transcaucasia (*c.* 2000 B.C.) with painted pottery in form and decoration startlingly like Hallstatt forms of a thousand years later.

More surprising are Prof. Kuftin's results obtained on the River Tsalka (lat. 41° 60′, long. 44°), tributary of the Khram, which is being dammed to get electric power. The U.S.S.R. is very good at seeing that such inundations are not made until the area has been examined for archæological remains. First he found barrows with the Hallstatt-like pottery, black glaze over pink; then two other types with light slip, one with shiny black rectilinear ornament, birds, chevrons and swastikas, the other with a cream slip adorned with spirals, volutes and rosettes. The burials were some on the original surface of the ground, others in great pits up to 14 m. long approached by a sloping way. Besides the pots with light slip, these yielded most remarkable metal work; for example, a gold cup adorned with filigree and jewels and set on a pierced base (looking almost like Byzantine work), a silver bucket with hunting scenes in repoussé gold, silver pins with filigree and gems, a silver blade, a necklace with very big beads, an agate pendant set in gold, also grey-blue beads which should help in determining affinities. Another grave had a socketed silver spearhead, not a common thing, and so making one think of the Borodino find, as the gold cups recall Vlči Trn, which likewise seems to belong to a painted pottery culture.

Many of these things resemble those from Ur and Uruk (2500–3000 B.C.) but the technical advance in gold work would seem to point to *c.* 1500 B.C., and the figure-work has some resemblance to Hittite sculpture at Yasilikaya, still untouched by Assyrian influence. There is certainly an element independent of Sumer and not unlike predynastic Egyptian, for example, the Gebel-el-Arak knife-handle. As there are no horses and no iron, we must not bring things down too late. The funeral car found in one tomb is still of the four-wheel type. Whatever the affinities of this new culture turn out to be, it is interesting to set another stone in the arch of painted pottery extending from Baluchistan by Iran and Asia Minor to Transylvania, and if we were bold, we might hope that we have the Hurri or kindred tribes before they moved south.

ELLIS H. MINNS.

PLANKTON OF IRISH LOUGHS*

W. H. Pearsall and Edna M. Lind have made some interesting preliminary researches into the analyses of the ecological relationships of the phytoplankton in numerous small Irish loughs. Twenty-six loughs were studied, ranging from one to seven kilometres in length. These are divided into (1) calcareous loughs (with Chara species abundant), subdivided into those with mainly soil drainage, and those with much peat drainage, and (2) the less calcareous loughs, subdivided into those with oxidized peat drainage, unoxidized peat drainage, the larger stream-fed loughs, and a few left unclassified. This classification agrees well with the algal distribution.

The plankton floras of the different loughs tend to fall into consistently different categories, of which at least four can be distinguished: those of the calcareous loughs with mainly soil drainage, those of the calcareous loughs with much peat drainage, those of less calcareous loughs with oxidized peat drainage, and the large stream-fed loughs. These four represent distinct plankton communities of algæ and as such they could be used in comparison with other plankton communities. The lists as a whole can be analysed to show the habitat range of individual algæ, which should be useful as indicators of water conditions.

The species are classified into three groups: *A*, those mainly characteristic of or most abundant in peaty conditions; *B*, those apparently indifferent to the presence or absence of peaty matter; *C*, those mainly characteristic of, or most abundant in, less peaty conditions. Among the indifferent species occurring in peaty conditions the cosmopolitan dinoflagellate *Ceratium hirundinella* is conspicuous. Diatoms, on the other hand, are less prominent in the peaty loughs but are numerous in the calcareous loughs. It is shown that the bulk of the calcifuge peaty species are distinctive in that they can grow almost equally well in bogs, and the non-pelagic character of these may mean that they are dependent on the presence of an adjacent peaty substratum. The truly planktonic species more characteristic of the less peaty water may have some feature of structure, life-history or metabolism which enables them to maintain a mainly pelagic existence in the large lakes.

The authors regard it as probable that the primary factor in distribution may be the nature of the dissolved solids carried into the lake from its drainage

* The Distribution of Phytoplankton in some North-west Irish Loughs. *Proc. Roy. Irish Acad.*, **48**, Sect. B, No. 1; March, 1942.

area, a conclusion already reached by the Wests (1909) and by Pearsall (1932). In the peaty loughs where acid conditions predominate these dissolved solids include a large proportion of vegetable organic matter in a slightly oxidized condition with a small amount of decomposition products, in contrast to the less peaty loughs where the organic matter carried into the loughs is comparatively highly oxidized with a large amount of products of oxidation including nitrates. The general effect of such conditions is the greater proportion of diatoms most noticeable in the calcareous loughs.

'BOG-BUTTER' FROM SKYE

THE practice of burying kegs of butter or body fat with the object of preserving or improving the flavour of the product continued in Ireland from an uncertain period of antiquity until the end of the eighteenth century. In Scotland, too, similar kegs of fat have been recovered from the peat bogs, though none of as recent date as some of the Irish finds that have come to light. The preservation of fatty substances has always been a problem of human economy which has only been partially solved in our own times with the advent of cold-storage, and the burying of kegs of fat in deep peat holes and leaving them there for any length of time up to seven years, when the flavour is said to be at its best, was probably a considerable contribution towards its solution.

The particular example now described by Prof. J. Ritchie (*Proc. Soc. Antiq. Scotland*, **75**; 1940–41) was discovered by Dr. Hugh Mackay in 1931, while peat was being cut about one mile east of the inn at Kilmaluag at the northern end of Skye. When found, the wooden keg was embedded in the solid peat bank, being tilted a little to one side. It would seem that it had been lowered into a fairly deep peat hole and for some reason forgotten or lost. The body of the barrel was hewn from a solid piece of wood, as also were the circular lid and bottom, though the diameter of the keg was some 15 inches and the tree from which it was made a birch. The workmanship was excellent, the thickness surprisingly uniform throughout. At the top of the barrel where the rim is otherwise bevelled off there are two upward projections nearly three inches high and each pierced by two holes, through one pair of which a cord could be passed for lowering the keg, while a small stick placed through the lower pair would have held the lid in place. Half-way up the body of the keg and not symmetrically placed on its circumference there are two more projections, this time lug-like, the holes having been burnt through the solid wood. It is suggested that these were useful when the keg was slung over a horse's back.

The mass of buttery fat itself has been analysed, but what it was originally could not be certainly determined. Some hairs were present, however, in the amorphous mass, which were mostly those of cattle, though a few human, dog and horse ones were also identified. On the whole, this would tend to suggest that the fat was originally a true butter.

Various methods were used in attempts to date the find—pollen analysis, associated finds, etc.—but no conclusive results could be given. Considering everything the writers are inclined to ascribe the find to the opening years of the Christian era.

M. C. BURKITT.

MELLON INSTITUTE OF INDUSTRIAL RESEARCH

THE twenty-ninth report of the Director of the Mellon Institute of Industrial Research, covering the year ended February 28, 1942, refers to the increase of the industrial research staff from 187 to 205 fellows and from 114 to 150 fellowship assistants engaged on some ninety-five industrial fellowships. Of the eight fellowships terminated during the year, that on carbon blacks as absorbents was concluded by a study of the activation of colloidal carbons with the object of determining their possibilities for use in absorption either in their original form or after treatment. Some carbon blacks prepared in pellet form with a suitable binder and activated by steam showed remarkable increases in their capacities for absorbing vapours and for purifying water.

Special interest is attached to the investigations of the Department for Research in Pure Chemistry, and studies in the chemistry and chemotherapy of modified cinchona alkaloids and related drugs have continued. In experience to date, no beneficial result of quinine cannot be obtained equally well with hydroxyethylapocupreine, a drug which is greatly superior to quinine in pneumonia, in infections of the eye and throat and in certain asthmatic conditions. In view of possible difficulty in obtaining adequate supplies, cinchona alkaloids investigations are in progress aiming at the preparation of simpler compounds which can be prepared from more easily available materials. Studies have also been carried out for the twelfth revision of the U.S. Pharmacopeia, and a number of projects have been subsidized by the Mellon Institute at the Institute of Pathology of the Western Pennsylvania Hospital, particularly on the effects of the sulphonamides on the tissues of the host and on the infecting agent in the tissues. A new sulphhydryl preparation ('Hydrosulphosol') has been found to be of value in the treatment of burns, stimulating rapid healing and discouraging infection. Other work has continued on natural resistance and the common cold, and on the role of certain enzymes in the metabolism of oxygen and carbon dioxide.

Particular reference is made to the work of the Industrial Hygiene Foundation, a combined research and service association for health protection in industry which maintains its headquarters at the Mellon Institute; this Foundation was originally known as the Air Hygiene Foundation, the change of name having been made during the past year. The investigations of the Foundation have covered the effect of arc-welding fumes on susceptibility to tuberculosis, the reactions of living tissues to silica granules, the evaluation of X-ray films for use in physical examinations in industry, and on the present exhaust ventilation systems for control of health hazards. Since early in 1941, the Foundation has been studying sickness absenteeism in industry, and fatigue is also receiving constant consideration. Work on aluminium powder as a possible preventative in silicosis is also reviewed in the report.

Of other industrial fellowships completed during the year reference is made to work on new pre-cast concrete units such as columns, girders and hollow floor and wall panels, the speed of erection of which is the basis of their utility, and an investigation on safety fuses initiated in 1930 has also been completed. With regard to fellowship researches in progress, 'Anthrafloss' is a high-grade mineral wool for insulat-

ing purposes developed from anthracite by-products by the multiple fellowship of the Anthracite Industries Incorporated. The multiple fellowship on heat insulation and proofing has assisted in the development of an efficient insulating material suitable for use for temperatures up to and including 800° C. The research programme of the multiple fellowship on plastic metals has resulted in the construction of a large commercial sponge-iron plant. Other fellowships have led to improvement in the manufacture of grey cast iron and steel, while a further fellowship has been devoted to the refining of chromium. Steady progress has been made in the utilization of waste pickle liquor under a multiple fellowship of the American Iron and Steel Institute. Five potential processes for the recovery of materials from this industrial waste have been investigated, including the recovery of free sulphuric acid and ferrous sulphate, the manufacture of iron carbonate and ammonium sulphate, the manufacture of magnesium from low-grade ores by heating with waste pickle liquor and the preparation of sodium sulphate and ferric chloride. Other fellowship researches have related to cast iron enamelling, hollow-ware enamelling materials, flat glass and waste grinding sand from plate glass manufacture. Substantial advances in methods for evaluating the flatness and texture of surfaces has been achieved under the multiple fellowship on plate glass technology.

Under the multiple industrial fellowship on sulphur investigations relating to sulphur cements, reaction of gaseous olefines with sulphur and the use of sulphur as a filtering medium are in progress. The same group has discovered a novel series of accelerators for rubber, as well as prepared further organic derivatives from ammonium thiocyanate. The upgrading of the components of coke-oven light oil, the physical properties of tars and pitches and their improvement, as well as the development of new products from tars, the commercial recovery of cyclopentadiene and the recovery of isobutane and isopentane from natural petroleum and casing-head petroleum have been investigated under other fellowships. The feasibility of installing a butane extraction plant, a product used in the manufacture of butadiene for synthetic rubber, has been demonstrated. Other work in the field of natural gas technology has related to corrosion problems. The multiple fellowship on petroleum has again been very active, its investigations including a study of the chemical constitution of high-melting waxes, research on fractional distillation under diffusion pump vacuum and on the chemistry of petroleum.

The multiple fellowship on organic syntheses established by the Carbide and Carbon Chemical Co. has extended its investigations on the manufacture and application of amines, detergents, lubricants, hydraulic fluids and synthetic resins, and a soluble lubricant for processing woollen fibres has been developed. The fellowship on chemical hygiene has continued its investigations on the physiological effects of new chemical compounds including the 'Tergetol' penetrants and the acute oral toxicity of glycol derivatives. The multiple fellowship on food varieties has perfected a new type of instant baby cereal, and initiated a project which will survey the whole field of fruit flavours; problems of the rapid tenderization of meat have also been investigated.

Cotton investigations have included studies on the fibre, the practicability and methods of adapting virgin cotton to the manufacture of high-grade papers, and fundamental research on the properties and structure of cotton cellulose and the influence of such processes as mercerization. Encouraging progress has been made in research on cotton-seed, and the industrial fellowship on felt has devised methods for imparting to paper, machine felts and other woollen industrial fabrics markedly improved physical characteristics and resistance to chemical injury, and has also devised a process for rendering wool and woollen fabrics non-shrinking and non-felting. An improved system of wool scouring and scouring control has given an average daily increase in production of more than 75 per cent. A third textile fellowship has led to important advances in processing hosiery yarn, particularly 'Nylon'. Yields and grades of glue have been improved by a fellowship on bone products which has also investigated granular absorbents for use in sugar refining. The fundamental problems of rubber technology are being studied by another fellowship, and 'Raolin', a special chlorinated rubber, developed by a Mellon fellowship research, is being allocated according to Federal Government instructions. Research on polymerizable silicon compounds is being carried on under a further fellowship and certain applications have been proposed which are of potential utility in warfare. Other research is related to the use of plastics in water- and gas-meters and for many other purposes.

HEAT ENERGY FROM RADIOACTIVE SOURCES IN THE EARTH

THE supremely important subject of the amount of heat derived from radioactivity within the earth is the subject of a recent paper by William D. Urry, of the Geophysical Laboratory, Washington ("Heat Energy from Radioactive Sources in the Earth", *J. Wash. Acad. Sci.*, **31**, 273–84; July, 1941), who has arrived at some very important conclusions. Older methods of determining the rate of heat production in particular specimens by examining the radon or thoron content were very cumbersome and thus few specimens were examined. Urry has taken a suggestion by the Director of the Laboratory and has examined a method of finding this rate of heat production merely by counting the rate of alpha particle emission in an ionization chamber. He finds that

$$H = 2{\cdot}1 \times 10^{-9} N,$$

where H is the heat produced in calories per gram of specimen per year and N is the total number of alpha particles emitted per gram per hour from the specimen. Heat accompanying the disintegration of potassium must be added to this and is equal to $4{\cdot}3 \times 10^{-6}\ a$ calories per gram per year, where a is gm. K_2O per gm. of specimen. This equation is possible since an error of less than 5 per cent is introduced by taking a fixed thorium uranium ratio in all previously examined types of rocks (acid to ultrabasic) and meteorites (iron and stony) where this ratio ranges from 0 to 20.

The author has examined the question of the variation of this heat production in geological history, and estimates that no significant increase in heat production within the structure of the earth has occurred during the accepted age of the earth (2×10^9 years). Further, in the opinion of Urry, hitherto undetected

radio-elements could contribute an appreciable quantity of heat only before $1{\cdot}5 \times 10^9$ years ago.

The new method should facilitate adequate rapid observation (geothermal problems) of great numbers of rock specimens, and should thus in due course present us with a mass of observational data for the study of the influence of heat derived from radioactive materials on the thermal history of the earth, besides contributing data to assist in the solution of present geotectonic problems.

BEHAVIOUR OF SULPHUR IN RUBBER

ACCORDING to G. G. Winspear (*Bell Lab. Rec.*, **20**, No. 8, April, 1942) vulcanized rubber may have a wide variety of characteristics depending on the amount of sulphur, the period and temperature of vulcanization, and the other substances compounded with it. Identical rubber compositions, vulcanized for the same time and at the same temperature, do not always develop the same characteristics. One of the unsatisfactory conditions that sometimes appears is spottiness, indicating a lack of homogeneity in the product. Before the sulphur assumes a position in the rubber molecule, it dissolves, and to secure uniform solution the sulphur is first dispersed evenly throughout the rubber mass. When sulphur and rubber are mixed on a mill the sulphur is dispersed throughout the rubber mass but most of it is in particles of measurable size. Although the particles may be small, and perhaps even invisible to the unaided eye, they are still very large compared to the sulphur molecule, so that the mixture is far from being one where all the sulphur is in immediate contact with the rubber molecules, which is the theoretical state required to give a homogeneous solution of sulphur in rubber. Such an intimate mixture results from a diffusion of the sulphur of each particle following the dispersion on the mill.

If rubber including a small percentage of sulphur is thoroughly mixed and then held for a long enough time at a high enough temperature, all the sulphur will go into solution. From its original particles the sulphur will diffuse until the whole mass of rubber is thoroughly permeated, and if the temperature is high enough all the sulphur will be dissolved. Rubber in thin sheets with completely dissolved sulphur is clear and transparent while if it contains undissolved sulphur crystals it will be cloudy. After a known amount of sulphur has all been dissolved in a sheet of rubber some of the sulphur will begin to crystallize out if the temperature is lowered sufficiently, because the lower the temperature the less sulphur will the rubber dissolve. This precipitation of sulphur will be evidenced by the fact that rubber will take on a cloudy appearance.

The interval between mixing and vulcanization is also important. At the end of the mixing period the rubber is at a fairly high temperature and the amount of sulphur in solution will correspond to this temperature. If the rubber is now set aside it will cool and some of the sulphur will crystallize in fine structure dendritic form. When the rubber is again heated in the vulcanizing process the crystals go back readily into solution. If the rubber is allowed to stand for a more extended period before vulcanization, however, the dendritic crystals gradually change to larger rhombic sulphur crystals, so that when the rubber is vulcanized, the sulphur thus crystallized cannot as readily get back into solution because of the time required for completely dissolving these larger crystals. The formation of these rhombic crystals is undoubtedly the cause of some of the spotty conditions sometimes found in vulcanized rubber.

ELECTRICAL ENGINEERING IN THE UNITED STATES

ARCHER E. KNOWLTON, associate editor of the *Electrical World* (United States), in a review (*J. Inst. Elec. Eng.*, **89**, Pt. 1, No. 18, June, 1942) of electrical engineering progress in the United States during the past 2–2½ years, points out that in 1941 and after, investigation and research have been redirected substantially towards military measures. Many developments arising out of the pressure for superior arms of every description are already regarded as having great import for the resumption of peace-time pursuits. Weights of electrical equipment are likely to be reduced as the results of iron research, and working temperatures of many kinds of equipment may be increased on account of alloy research.

Outstanding in the latter half of the period under review were the incentives to standardize, to simplify, to eke out and to compensate, in order that suddenly taxed systems could meet the exacting requirements of defence loadings with the least drain on capital, production facilities and installation forces. Also, the technique of proofing overhead lines against lightning made it possible to render a single line practically as reliable in performance as double circuits had been. Higher speed circuit-breakers, reclosure, earth-fault neutralizers, protector tubes, counterpoises, arresters, insulation co-ordination for impulses were all factors in creating effective immunity to the surges which precipitate outages.

In the field of power distribution, reliability of service vied with the imperative need for conservation of capital, and these two somewhat contradictory objectives can claim the bulk of the developments in power distribution. Among these might be mentioned sectionalization of radial feeders, reclosure, networks, banking of secondaries, rebalanced transformer losses, extensive application of corrective capacitors, surveys of thermal margins of apparatus, unit substations, step regulators, improved cables, etc. Change and uncertainty of location of defence loads, as well as the provision of spares for emergencies, have more recently prompted a considerable adoption of portable substations and capacitor banks.

The paper reviews more particularly and in a very condensed form the developments which have taken place in large generators, power generation, transformers, transmission, circuit interruption, relaying, lightning, switching and substations, cables, insulation, capacitors, power distribution, instruments, electronics and electrostatics, motors and control, industrial applications, transportations, rectifiers, electrothermics and electrochemistry, welding, illumination, and certain miscellaneous developments.

ELECTROMAGNETIC WAVES IN METAL TUBES OF RECTANGULAR CROSS-SECTION

AN article by J. Kemp (*Electrical Communication*, **20**, No. 2, 1941) shows how the attenuation of electromagnetic waves propagated through the interior of rectangular metal tubes is calculated by the familiar telephone transmission formulæ, the top and bottom of the tube being regarded as zigzag flat-strip transmission lines while the side walls, when suitably disposed, are regarded as transmission lines of another type. From the losses occurring in these lines, the attenuation offered by the tube is obtained in a simple manner. The general formula for the attenuation of all types of waves in metal tubes of all cross-sections has been established by Schelkunoff. Chu and Barrow have also derived attenuation formulæ for all types of waves supported by tubes of rectangular cross-section. The method so far followed has involved the computation of the energy flow in the direction of the tube and the power losses in the walls by means of the Poynting flux theorem.

Electromagnetic waves in metal tubes are characterized by two essential features. There is a minimum frequency below which no waves are supported by the tube. This minimum or cut-off frequency is determined by the shape and the size of the tube. As the wave-length of the cut-off frequency is of the order of the cross-sectional dimension of the tube, the frequencies of the possible waves—for air-filled tubes having dimensions in the centimetre range—are of the order of 10^9 c./s. and above.

The second feature is that there is either an electric or a magnetic intensity in the direction of propagation of the waves, that is, along the tube. For electromagnetic waves in free space the electric and the magnetic intensities are in planes at right angles to the direction of propagation. When, however, waves are restricted to the inside of metal tubes there is, in addition to the electric and magnetic intensities of the free-space waves, either an electric or a magnetic intensity in the direction of propagation. It is customary to use this additional property of these waves for their classification. When there is an electric intensity in the direction of propagation, the wave is designated an *E*-wave. When there is a magnetic intensity in the direction of propagation, the wave is designated an *H*-wave.

The article proceeds to the mathematics of the problem and it is shown that the method reveals the existence of a link between two seemingly disjointed branches of telecommunication: (1) telecommunication of the classical character, employing a 'circuit', that is, a system comprising a 'go' and a 'return' path, and (2) telecommunication through hollow metal tubes without a return path in the conventional sense. The final expression for the attenuation constant of waves propagated through hollow metal tubes is derived in a simple manner from the familiar equations for the attenuation of telephone lines, with due regard to the reflexion loss at the junction of dissimilar lines, and the numerical results obtained by the shortened method agree in every respect with those obtained by more elaborate means by other investigators. The simplicity of the method arises from the fact that the telephone transmission formulæ contain implicitly the concepts required in the detailed calculation by orthodox procedure.

FORTHCOMING EVENTS

Wednesday, July 8

INSTITUTE OF PHYSICS (ELECTRONICS GROUP) (at the Royal Institution, 21 Albemarle Street, London, W.1), at 5 p.m.—Discussion on "Cathode Ray Tubes".

Thursday, July 9

INSTITUTE OF SEWAGE PURIFICATION (at Friends House, Euston Road, London, N.W.1), at 2.30 p.m.—Dr. E. M. Crowther: "The Manurial Value of Sewage Sludges"; Mr. J. Hurley: "A Critical Review of Recent Work on Sewage Filtration". July 10 (morning), Visit to Rothamsted Experimental Station, Harpenden, Herts.

Friday, July 10

SOCIETY OF CHEMICAL INDUSTRY (at the Royal Institution, Albemarle Street, London, W.1), at 2.30 p.m.—Annual General Meeting; at 3 p.m.—Presidential Address.

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Discussion on "The Structure and Rotation of Galaxies" (to be opened by Dr. A. Hunter, Dr. H. A. Brück, Sir Arthur Eddington, O.M., F.R.S., Dr. H. Spencer Jones, F.R.S.).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

HEAD OF THE BUILDING DEPARTMENT of the Croydon Polytechnic—The Education Officer, Education Office, Katherine Street, Croydon (July 9).

LECTURER (WOMAN) IN PHYSIOLOGY, ANATOMY AND HYGIENE at the Dunfermline College of Hygiene and Physical Education—The Executive Officer, National Committee for the Training of Teachers, 140 Princes Street, Edinburgh 2 (July 10).

LECTURER IN PHYSICS—The Principal, Royal Technical College, Salford (July 10).

VETERINARY INVESTIGATION OFFICER—The Secretary, West of Scotland Agricultural College, 6 Blythswood Square, Glasgow (July 10).

TEACHER OF ENGINEERING SUBJECTS at the Redditch Technical School—The Secretary to the Worcestershire Education Committee, Education Office, Church Green West, Redditch (July 11).

GRADUATE ASSISTANT MISTRESS to teach General Science including Biology and Geography—The Principal, Technical Institute, Tunbridge Wells (July 13).

GRADUATE LECTURER IN MECHANICAL ENGINEERING SUBJECTS at the Denbighshire Technical Institute, Wrexham—The Director of Education, Education Offices, Ruthin (July 13).

LECTURER IN PHYSICS (MAN OR WOMAN)—The Registrar, North Gloucestershire Technical College, Cheltenham (July 13).

LECTURER IN COLOURING MATTERS—The Registrar, College of Technology, Manchester 1 (July 13).

VETERINARY BACTERIOLOGIST—The Registrar, King's College, Newcastle-upon-Tyne 2 (July 20).

WATER ENGINEER AND MANAGER to the Corporation of Swansea—The Town Clerk, The Guildhall, Swansea (July 20).

ASSISTANT FOR WORKSHOP AND GENERAL ENGINEERING SUBJECTS—The Principal, Erith Technical College, Belvedere, Erith, Kent.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Ross Institute of Tropical Hygiene. Some Emergency Anti-Malarial Measures. By Sir Malcolm Watson. Pp. 8+8 plates. (London: Ross Institute of Tropical Hygiene.) [226

Annual Report of the Fitzwilliam Museum Syndicate for the Year 1941. Pp. 10. (Cambridge: Fitzwilliam Museum.) [226

Friends of the Fitzwilliam Museum. Thirty-third Annual Report for the Year 1941. Pp. 4. (Cambridge: Fitzwilliam Museum.) [226

Other Countries

Air Department: New Zealand Meteorological Office. Professional Note No. 1: Synoptic Analysis over the Southern Oceans. By C. E. Palmer. Pp. iv+38+39 plates. (Wellington: Meteorological Office.) [126

Forest Research in India, 1940–41. Part 2: Reports for Burma and Indian Provinces. Pp. iii+242. (Dehra Dun: Manager of Publications.) 3.12 rupees: 6s. [176

Records of the Geological Survey of India. Vol. 75, Professional Paper No. 15: The Charnockite Series of Bastar State and Western Jeypore. By P. K. Ghosh. Pp. iii+55+viii+8 plates. (Calcutta: Geological Survey of India.) 2.2 rupees; 3s. 6d. [226

Forest Research Institute. Utilisation, Bulletin No. 105: The Variation of the Electrical Resistance of Indian Timbers with Moisture Content. By D. Narayanamurti. Pp. iii+7+5 plates. (Delhi: Manager of Publications.) 8 annas; 9d. [226

Ontario Research Foundation. Report for the Year 1941. Pp. 25. (Toronto: Ontario Research Foundation.) [226